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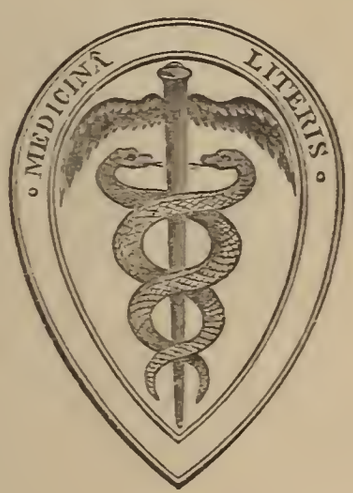
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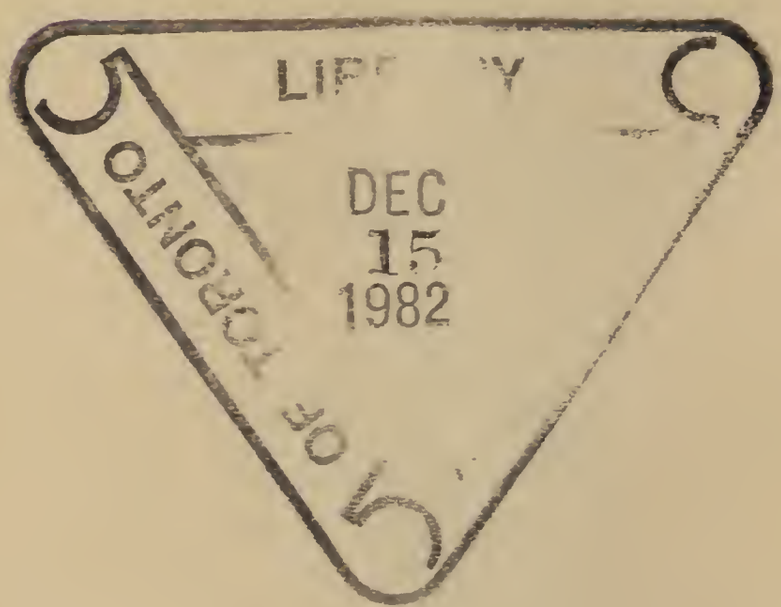


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PREFACE TO THE SECOND EDITION.

The very favourable manner in which this Manual has been received by the members of the Legal and Medical professions, has rendered it necessary to prepare a second edition within a comparatively short period. For this kind reception, I must return my thanks to the editors of those British Journals, who, while according to the volume a degree of approbation which I had no reason to expect, have done me the favour to make it extensively known.

That some difference of opinion should exist concerning the best method of treating a subject, so varied in its applications and so closely connected with the whole circle of the Medical Sciences, is not surprising; and in preparing this edition I have endeavoured to profit by those hints for improvement, which have been given in a kind and friendly spirit. I have not, however, thought it advisable to adopt any formal arrangement of the contents of the volume: each prominent subject has been separately treated in sections; and independently of a very copious index, the contents of each page are fully indicated by the heading attached. It is presumed, therefore, that by these means the objects of the best arrangement which could be devised, are amply fulfilled, and that no difficulty will be experienced by those who have occasion to consult the work.

Since the publication of the first edition, many trials have taken place both in this country and on the Continent, which, although they

have not materially affected the general principles of the science, have rendered the revision of some statements, and the addition of others absolutely necessary. In the section on POISONING, I have thought it advisable to make a few alterations, in order that I might be enabled to introduce the principal discoveries made in Toxicology, during the last two years. Among the changes may be enumerated,—the omission of some chemical processes for detecting poisons, and the substitution of others which appeared more simple,—a description of the methods employed for detecting poisons when absorbed into the tissues,—additions to the sections on arsenic, lead, copper and opium —new facts connected with the smallest fatal doses of poisons, and the shortest periods for their operation,—cases illustrating the fatal effects which ensue from their external application;—and lastly, the strength of all medicinal preparations which contain poison. The chapter on prussic acid has been almost entirely re-written; and in this edition will be found sections on poisoning by the Tartaric and Acetic acids, Lime, Phosphorus, Phosphoric acid, Chromate of Lead, Elder and Laburnum.

To devote one third of the volume to Toxicology, may at first sight appear to be assigning to that subject more than its fair proportion; but having closely examined the works of Orfila, Devergie, Barzellotti, and other standard writers on this science, I find that I have done no more than those whose example will be deemed worthy of imitation.* Cases of poisoning form about *forty-five* per cent. of all those in which the law requires evidence from the British medical practitioner. I rest this statement upon the collection of a large number, which have come before our legal tribunals during the last fifteen years; and it appears to me, that no one acquainted with the science, will hesitate to admit, that considering the frequent occurrence of cases, and the variety, intricacy and importance of the questions that arise, there is no medico-legal subject which requires to be so fully treated, as that of *poisoning*. It

* The work of the late Professor Barzellotti—"Questioni di Medicina Legale, secondo lo spirito delle Leggi Civili e Penali veglianti nei Governi d' Italia, (Pisa, 1836,) is but little known in England; although it is one of the most comprehensive treatises in modern medico-legal literature. The three volumes contain 1700 closely printed large 8vo pages, of which one volume of upwards of 700 pages, is devoted to Toxicology alone!

is indeed utterly impossible to comprise within a small compass, the numerous facts upon which information is almost daily demanded. *

Numerous additions and alterations have been made in the chapters on WOUNDS and INFANTICIDE. The sections on RAPE, PREGNANCY, DELIVERY and ABORTION, have been also enlarged; and some additions have been made to that of INSANITY, including the changes respecting medical certificates and the discharge of lunatics, under the new Lunacy Act.

In making the additions to these last-mentioned subjects, I have had to bear in mind that I was engaged in writing a compendious Manual, and not an elaborate treatise on the science; and that it would be therefore improper to occupy space with discussions, which could lead to no practical utility, or upon questions which seldom present themselves in practice. It appears to me that an author, who professes to publish a compendious practical work on Medical Jurisprudence, is bound to consider what subjects most frequently require investigation in the hands of medical practitioners, and apportion his space accordingly. From many hundreds of cases in my possession, I find that about ninety per cent. involve questions relating to *poisoning*, *wounds*, and *child-murder*. Guided by this principle, I have devoted the bulk of the volume to these three subjects.† Questions

* I am perfectly aware that notwithstanding the space devoted to it in this volume, there is room for the addition of much important matter, although probably not so directly connected with the duties of a medical jurist. It is this which has induced me to undertake the publication of a separate MANUAL of TOXICOLOGY, upon which I am now engaged.

† The following table has been drawn up from the accumulation of cases in my possession, extending over a period of fifteen years. Out of 100 cases requiring medical evidence either before the coroner or in the superior Courts of Law, there are of Poisoning, 45; Wounds and Personal Injuries, 35; Infanticide, 10; all other cases, 10.

With respect to the frequent occurrence of medico-legal cases, I find that by the Parliamentary returns of 1834,—exclusive of inquests on suicides—there were in that year 1213 trials, involving questions of murder and manslaughter, either perpetrated or attempted from *poisoning* and *wounds* or personal injuries. Of these there were in England and Wales 473 cases,—in Scotland 46,—in Ireland 694. The number of cases has certainly not diminished in the interval that has elapsed since the publication of that report. The last report of the Registrar-general (1844), shows that in the year 1840, there were 349 *ascertained* deaths from *poison* in England and Wales alone! See page 68.

connected with *rape* rarely create much difficulty, or give much scope for discussion: in the greater number of cases tried in England, medical evidence has been only subordinate: those connected with *pregnancy* and *delivery*, except so far as they relate to infanticide and criminal abortion, rather refer to the duties of the accoucheur, than of the medical jurist. The strictly *medico-legal* relations of *pregnancy* are so limited and so rarely present themselves, that I have not considered myself justified in increasing the size of the work by introducing subjects which are better and more appropriately treated in works on midwifery. Besides, in any case of real difficulty, the witnesses are commonly selected from among men who occupy a high standing as practical obstetricians.* To them, of course, this Manual is not addressed.

I have been guided by the same principles in remodelling the section on INSANITY. It would have been easy to have added considerably to this subject; but by avoiding metaphysical discussions on criminal responsibility, and omitting the purely medical history of the various forms of insanity, it has been brought within a space which will probably be found sufficient for the guidance of a practitioner, in the few cases in which his evidence may be required.

I must here express my thanks to many unknown friends of the medical and legal professions, who have done me the favour to forward illustrative cases. Most of these have been introduced into the present edition,—often much more concisely than I could have desired, owing to the necessity under which I was placed of confining the work within certain limits. For the same reason I have been compelled in many instances to give a mere reference to medical journals, instead of extracting an outline of each case.

MEDICAL JURISPRUDENCE may be defined to be *that science, which teaches the application of every branch of medical knowledge to the purposes of the law.*† Its claims, as a distinct science, to the atten-

* See the Gardner Peerage case, and others.

† It has been proposed to substitute the term "FORENSIC MEDICINE" for this science. MEDICAL JURISPRUDENCE, however, comprises not merely *forensic* but *extra-forensic* medicine, i. e. the application of medicine to Legislation and Medical Police. It appears to me to be unadvisable to make any

tion of the profession rest upon two grounds: 1st, that the subjects of which it treats are of practical importance to society; and 2nd, that they are not included in the other branches of a medical education. How far these positions are borne out by facts, will be best understood by a reference to the contents of this Manual.

It is unnecessary for me to remark that great responsibility is attached to the duties of a medical witness, and that any member of the profession may find himself involved in this responsibility, from circumstances of a merely accidental nature. When a crime, requiring medical evidence for its elucidation, is perpetrated, the duty of the whole investigation commonly devolves on the practitioner, who lives nearest to the spot: it is therefore virtually upon his knowledge and experience, that the clear proof of the crime and the legal punishment of the offender, must rest. He should remember that his duty lies strictly in developing *medical* proofs; and he must endeavour to lay aside that feeling, which often induces us to see a criminal in every one who happens to be accused:—"*priùs est de crimine quàm de reo inquirendum.*"—(GROTIUS.) I trust that I may not be found to have departed from this maxim in treating the subjects contained in this Manual. While I have endeavoured to bring forward every medical point necessary to establish a crime, I have not concealed the very numerous objections to which medical evidence is exposed. On one side, my object has been to establish guilt,—on the other, to vindicate innocence. Whether in any case requiring medical evidence, a person be wrongly or rightly accused, is a question which rests with the jury, and not with the witness. In recent times, however, it has been customary to speak of a *medical* prosecution and defence. A witness who thus places himself in the position of a medical counsel, entirely forgets that his evidence should always be given with a

alteration in a name which has received the sanction of Beck and Christison, and which has been employed for forty years to designate the only endowed professorship of the science in the United Kingdom—that of Edinburgh. Besides, if any alteration were made, it would be assuredly unwise to substitute a name which has a more restricted application. *Forensic* medicine conveys no more the meaning of the *Médécine Légale* of the French,—the *Medicina Legale* of the Italians, or the *Gerichtliche Medicin* of the Germans, than it does of the Medical Jurisprudence of England and America; and as one proof of this, so far as our own literature is concerned, it may be stated that works professedly on Forensic Medicine, are often advertised as works on Medical Jurisprudence!

view,—not to the acquittal or conviction of a particular individual, but to the vindication of justice, and the due protection of society! He appears for the country, and neither for the Crown nor the prisoner. He is bound to state conscientiously, without scruple or reservation, the *whole* of the medical facts and doctrines which may be necessary to bring out the truth. An unqualified answer, returned to a general question, may be the means of sending a fellow-creature into eternity;—and morally debased must be the mind of that individual, who, because he has been selected as a witness either for the prosecution or defence, thinks that he is justified in giving only as evidence what may appear to favour the prosecutor or the prisoner. He should remember that his oath binds him to speak *the whole truth*, and not merely so much as may serve the party by whom he is summoned. If he has not the courage to place himself in this position, he is assuredly not qualified to act as a witness. He who would strain medical doctrines and distort medical evidence before men unable to test the grounds of his professional opinion, in order to extricate one whose guilt was apparent, would have very little scruple where his interest inclined him, to express opinions that might consign an innocent person to the hands of the executioner. The power of a medical witness in a Court of law is exceedingly great. If it be employed for good, it may be also employed for evil. A statement may be required as evidence, which will probably become the turning point of life and death to an accused person! Is such a statement to be made a subject of bargain and sale?—Yet if medical witnesses once give way to the temptation of rendering themselves partial advocates, it is impossible to say to what results, the practice may ultimately lead. There is a wide distinction between a barrister and a witness on these occasions: the lawyer, it has been well observed, is known as his client's advocate, and not as the advocate of justice; and he is heard by a jury with this understanding. But has a medical witness any such plea for employing his professional knowledge to induce a jury to believe, by equivocating answers, what he knows they would immediately reject if they were only as well acquainted as himself with medical facts and opinions? To answer this question, I would say, let him hear sentence of death pronounced against a fellow-being upon such evidence,—let him, if he can, be a calm spectator of a scene which is commonly sufficient to move the sternest feeling, and let his conscience then tell

him whether in thus acting, he has performed his duty to God and man ! "*Lorsque la justice demande des lumières de la médecine, les explications de celle-ci doivent être aussi complétes que possible. Un expert doit donc dire tout ce que la conscience lui inspire, quand ses observations sont d'ailleurs le resultat de l'examen attentif, qu'il a fait du sujet sur lequel on demande son opinion. Il est de son devoir de dire alors tout ce qu'il croit de nature a favoriser la découverte de la verité : il aurait tort de borner ses réponses aux questions qui lui sont posées, s'il ne peut exprimer de la sorte toute sa pensée..**

* Ollivier (d'Angers) Annales D'Hygiène et de Médecine Legale. 1842, . 342.

3, Cambridge Place, Regent's Park,
December, 1845.

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A MANUAL

OF

MEDICAL JURISPRUDENCE.

POISONING.

CHAPTER I.

DEFINITION OF A POISON. HABIT AND IDIOSYNCRASY.

A POISON is commonly defined to be a substance which when administered in small quantity is capable of acting deleteriously on the body. It is obvious that this definition is too restricted for the purposes of medical jurisprudence. It would, if admitted, exclude a very large class of substances the poisonous properties of which cannot be disputed ;—as for example, the salts of lead, copper, tin, zinc and antimony, which are only poisonous when administered in very large doses.

Nitre it is well known exerts a poisonous action only in large, while arsenic is poisonous in small doses ; but in a medico-legal view, whether a person die from the effects of an ounce of nitre, or of five grains of arsenic, is a matter of little importance. Each substance must be regarded as a poison, differing from the other only in its degree of activity and perhaps in its mode of operation. The result is the same ; death is caused by the substance taken, and the quantity required to kill cannot therefore be made a ground for distinguishing a poisonous from a non-poisonous substance. If, then, a medical witness be asked, " What is a poison ?" he must beware of adopting this common definition, or of confining the term poison to those substances only, that operate in *small* doses.

The fact that a poison has been commonly regarded as a substance which produces serious effects when taken in small quantity, has induced many who have adopted this arbitrary view to assert, that certain substances which have actually been known to cause death, are not

poisons; and this doctrine has been apparently strengthened by the fact, that were not some such distinction adopted, it would be difficult to separate the class of poisons from bodies which are reputed inert. In answer to this view, it is perhaps sufficient to show, that there is no good reason for assuming this as the distinguishing character of a poison; for, it is impossible, even among substances universally admitted to be poisonous, to make any division according to the effects produced by the quantity taken. In relation to the quantity required to operate fatally, the difference is not so great between cream of tartar and oxalic acid, as between oxalic acid and strychnia. If we consider nitre and cream of tartar to be poisons, there seems to be no good reason for excluding common salt (the chloride of sodium). Medical practitioners would scarcely be prepared to admit this last-mentioned substance into the class of poisons; but it is to be observed that in a very large dose, it is capable of acting as a powerful irritant, and of inflaming the mucous membrane of the alimentary canal to the same extent, as much smaller doses of other well-known irritants. One instance is recorded where half a pound of this substance, swallowed for the purpose of expelling worms, destroyed the life of a young woman: and Dr. Christison mentions a case which occurred some years since in London, where a man swallowed a pound and died within twenty-four hours, under all the symptoms of irritant poisoning. There is another substance commonly reputed to be innocent; but which in a large dose may destroy life. This is the sulphate of magnesia, or Epsom salts.

A trial took place at the Huntingdon Autumn Assizes, 1842, in which two men were indicted for feloniously killing one Daniel Cox, by administering to him a large quantity of Epsom salts, dissolved in beer. The deceased was an old man and a confirmed drunkard, and he was in the habit of drinking beer to excess. On the day laid in the indictment, the deceased had drunk several pints of beer, which, it was afterwards proved, had been drugged with the sulphate of magnesia. He was seized with violent purging, and died within forty-eight hours. On a post-mortem examination, the lining membrane of the alimentary canal was found to be inflamed, and there was no doubt that death was owing to the irritant effects of the salt. One of the prisoners was convicted. The quantity of the substance taken in this case could not be ascertained, but there was reason to suppose that the dose was large.

A case is mentioned by Christison in which a boy ten years old, had two ounces of the sulphate of magnesia administered to him medicinally by his father, as a remedy for worms. The salt was taken partly dissolved in a tea-cupful of water, and very soon after it had been swallowed, the boy staggered and became unwell. When seen by a medical man half an hour afterwards, his pulse was imperceptible, his breathing slow and difficult, the whole frame in a state of great debility, and in ten minutes more, the child died without any other symptom of note, and particularly without any vomiting. (Treatise on Poisons, 491.) It is remarkable that in this case, there does not appear to have been any purging, and after death no morbid appearance was found in the body. It has been suggested that substances of this kind

connect the true poisons with those which are inert in regard to the economy: but they are assuredly to be regarded by the medical jurist as irritant poisons, and as to the dose administered, it is of little moment in medicine or in law, whether one grain of one substance or one ounce of another substance be taken, provided the fatal effects be clearly traceable to the action of the particular substance on the body. This is the point to which a medical jurist must direct his attention. The alkaline sulphates in large doses have been found to act in a similar way. (See SULPHATE OF POTASH, post.) In Medical Jurisprudence, therefore, it is necessary to look to the effects produced by particular substances on the system, and their adequacy to cause death under symptoms of poisoning, rather than to the mere quantities in which they may have been taken.

These remarks on the looseness of the common definition of the term poison have been suggested by the fact that medical men have been sometimes severely pressed in cross-examination on trials for certain criminal offences, to state what is strictly a poison, and what is not. We shall see hereafter that in charges of attempted poisoning, or of attempted abortion by the administration of drugs, it is not an indifferent matter for a witness to be able to say what substances are noxious and what are inert; or to show, how some bodies commonly reputed inert, may under certain conditions act deleteriously on the system.

There is another point of view in which this question may require to be considered, namely, What is to be understood by a *deadly* poison? In most indictments for poisoning, it is customary to describe every poison as *deadly*, a form of expression decidedly bad, and calculated to give rise to legal objections. The substance administered might with equal propriety be described as poisonous, or of a destructive nature; but those who draw up indictments are but little informed on such matters, and they can never speak of a poison without describing it as deadly. The following case occurred on the Norfolk Spring Circuit, 1836.

Two persons were capitally indicted for having feloniously caused to be administered to the prosecutor, a quantity of a certain "*deadly poison*," called sulphate of copper, (blue vitriol) with intent to murder him. It appeared in evidence that all the parties were servants in a farmer's family, and that it was the duty of one of the prisoners to prepare breakfast for the other servants. On the morning of the day laid in the indictment, the prosecutor observed, that the milk which had been prepared for him was very nauseous, and, after having taken a small quantity of it, he laid it aside. He was soon seized with violent vomiting, but under medical assistance he recovered. The residue of the milk was analysed, and was found to contain sulphate of copper. In the defence, the counsel for the prisoners contended that they could not be convicted of the crime charged in the indictment, since, according to all medical experience, the sulphate of copper was not a *deadly* poison. The medical witnesses, of whom there were two, were then required to give their opinions, but they differed on the point. One, a surgeon of some years' standing, considered it to be a deadly poison, although he admitted that so far as his own experience went, he had had no knowledge of its poisonous effects. The

other stated that it was not a deadly poison, and that when sold in a shop, the word poison was never attached to the label. The judge considered the case to be one of suspicion rather than of proof, and the prisoners were acquitted.

Although, by this summary disposal of the case, the force of the objection to the indictment was rather evaded than decided, yet the difference of opinion between the two medical witnesses is worthy of remark. The question may be easily raised again, and there ought to be some understanding among practitioners as to the proper signification of the word *deadly* when applied to poisons.

It appears to me that the term *deadly* can be used with respect to those poisons only which may prove speedily fatal in small doses, such as strychnia, morphia, prussic acid and arsenic, and that it could not with any sort of propriety be applied to such substances as the sulphate of copper. The error essentially lies in the legal wording of the indictment, with which, of course, a medical witness is not concerned. If an objection of this kind is to be held valid, and a question of criminal poisoning to be dismissed on so trivial a point, it is reasonable to expect that greater care should be used in drawing up indictments, as also that medical terms should not be employed by non-medical persons without proper supervision:—otherwise, it is obvious that the ends of justice must be defeated. Differences of opinion among educated medical witnesses are not likely to exist where slight previous reflection has been bestowed upon the subject. After all, it must strike the reader that an objection of this kind is too trivial to be entertained. It would seem reasonable that the proof of the crime of poisoning should rest either upon the fact of the substance administered being a poison, or of its having the power of operating as such. Whether it be strictly of a deadly nature or not, should be considered a matter entirely subordinate to the main inquiry. This question again arose, and this work was quoted in reference to it, in the case of *Reg.* v. *Haydon*, Somerset Spring Assizes, 1845. The substance administered in this case was "spirits of hartshorn," which was most absurdly described as a "deadly poison." The counsel for the prisoner took an objection to the indictment on this ground, but the judge said, (Erle J.) "the word *deadly* appears to me to be used merely in pursuance of an ancient form, and not to be essential to the validity of the indictment. It would be sufficient to describe it simply as a poison, and under that term would fall anything calculated to destroy life. Substances harmless in themselves might become poisons by the time or manner of their administration. This seems to me the view most accordant with common sense, and therefore I hold this indictment to be good, even though it describes spirits of hartshorn as a *deadly poison*."—(Law Times, April 12, 1845.) The question may now, therefore, be considered as settled. The word *deadly* must be regarded as mere surplusage.

In legal medicine, it is difficult to give such a definition of a poison as shall be entirely free from objection. Perhaps the most comprehen-

sive definition which can be suggested is this: "A poison is a substance which, when taken internally, is capable of destroying life without acting mechanically on the system." Some substances, may, however, act as poisons by absorption when applied to the skin or a wounded surface; (See CORROSIVE SUBLIMATE, CANTHARIDES, and ARSENIC,) while others again, as the poison of the viper, and of hydrophobia, may have their fatal effects limited to those cases in which they are introduced by a wound.

Under the definition above given, it might be objected that the whole class of medicines, and numerous substances of an inert nature, would be included. Thus it is well known, that there are many cases on record, in which cold water, swallowed in large quantity, and in an excited state of the system, has led to the destruction of life either rapidly by shock, or slowly by inducing gastritis. Any cold liquid, such as iced water, beer, or ice itself, may have an equally fatal effect. The action of water or cold liquids, under these circumstances, cannot be said to be mechanical; it appears to be due to the shock suddenly induced on the nervous system through the lining membrane of the stomach, and yet it would be inconsistent to class these inert liquids among poisons. In regard to the effects of cold liquids and the medico-legal questions which arise respecting them, see an elaborate paper on the subject, by Dr. Guérard in the Annales d'Hygiène, 1842, i. 42.

In all cases of this description, it appears to me, that we are justified in drawing the following distinction between poisonous and non-poisonous substances. If the deleterious effect does not depend upon the nature of the substance taken, but upon the state of the system at the time at which it is swallowed, the substance cannot be regarded as a poison. All poisonous substances are *per se* deleterious,—the state of the system, setting aside for the present the peculiar effects of idiosyncrasy and habit, has very little influence on their operation. The symptoms may be suspended for a time or slightly modified in their progress, but sooner or later the poison will affect the healthy and diseased, the old and the young, with a uniformity in its effects, not to be easily mistaken. A distinction of this kind cannot, however, be drawn, except by a professional man, who has given attention to the subject of toxicology, and therefore it is no matter of surprise that poisoning should have been in more than one instance erroneously imputed, in cases where death has followed the drinking of cold liquids.

In thus giving the medical definition of a poison, it is necessary to observe that the law never regards the manner in which the substance administered, acts. If it be capable of injuring the health of an individual, it is of little consequence, so far as the responsibility of a prisoner is concerned, whether its action on the body be of a mechanical or chemical nature. Thus a substance which simply acts mechanically on the stomach, may, if wilfully administered with intent to injure, involve a person in a criminal charge, as much as if he had administered arsenic or any of the ordinary poisons. It is then necessary

that we should consider what the law strictly means by the act of poisoning. If the substance criminally administered destroy life, whatever may be its nature or mode of operation, the accused is tried on a charge of murder, or manslaughter, and the whole duty of the medical witness consists in showing that the substance taken, was the certain cause of death.

If, however, death be not a consequence, then the accused is tried under a particular statute for the attempt to murder by poison. (1 Vict. c. xxxv. sec. 2.) The words of this statute are very general, and embrace all kinds of substances, whether they be popularly or professionally regarded as poisons or not. Thus it is laid down that "Whosoever shall administer or cause to be taken by any person, any poison, or other destructive thing, with intent to commit murder, shall be guilty of felony, and being convicted thereof, shall suffer death." Whether the administering be followed by death or bodily injury dangerous to life, it is still a capital felony provided the *intent* have been to commit murder. The same administering with intent, &c., although no bodily injury be effected, is felony, punishable by transportation for life, for fifteen years, or imprisonment for any term not exceeding three years.

Such is the present state of the law of England in respect to attempts at poisoning where death does not take place. While the words of the statute render it unnecessary for a medical witness, in such cases, to give judicially a very close definition of "a poison," they impose upon him a difficulty which he must be prepared to meet. The substance administered may not be a poison in the medical signification of the term, nor may it be popularly considered as such, and yet, when taken, it may be destructive to life. We have examples of substances of this description in iron filings, powdered glass, pins and needles, and such like bodies, all of which have been administered with the wilful design of injuring, and have on various occasions given rise to criminal charges. In cases of this kind, the legal guilt of a prisoner may often depend on the meaning assigned by a medical witness to the words *destructive thing*. Thus, to take an example,—liquid mercury might be poured down the throat of a young infant, with the deliberate intent to destroy it. A question of a purely medical nature will then arise whether mercury be "a destructive thing" or not; and the conviction of the prisoner will probably depend on the answer returned by the witnesses. Should a difference of opinion exist,—an occurrence by no means unusual in medical evidence, the prisoner will, according to the humane principle of our law, receive the benefit of the doubt. The point which here requires to be considered is, why any difference of opinion should exist among witnesses.

With regard to the case just supposed, it is a general principle in toxicology, that the pure metals are not poisonous; and they are not to be regarded as "things" destructive to life, unless the mechanical form in which they are taken, be such as to injure the viscera with which they may come in contact, leading to inflammation and its conse-

quences. Even where the mechanical form favours the production of these serious results, especially perforation of the intestines, the powers of nature are often exerted in a most extraordinary way, and the individual lives apparently in good health. This has been witnessed in the cases of many who have swallowed knives or pins and needles. The escape of such persons must, however, be regarded as the result of accident. They are always in imminent danger, and they commonly die sooner or later from inflammation or perforation of the viscera. For a remarkable case in which death took place from this cause in Guy's Hospital, see Medical and Physical Journal, October, 1809, p. 350. The masses of iron which caused death in this case are preserved in the Museum collection. For another interesting case in which death took place from disease of the brain, and a large number of iron nails and other metallic substances were found in the stomach, see Dublin Medical Journal, September, 1835, also Med. Gaz. xvi. p. 791.

Liquid mercury, the substance which we have taken as an illustration, cannot operate deleteriously on the body either chemically or mechanically. It may be taken, and has often been swallowed in very considerable quantities, without perceptibly affecting the health. If a medical witness were not aware of these facts, and did not sufficiently reflect upon the nature of the question addressed to him, he might improperly cause the conviction of an accused party. The intention of the accused may have been criminal, but that is a matter unconnected with the duties of a witness:—he is simply required to state whether the means employed to carry out this criminal intention, were such as were likely to produce danger to life. Similar observations might be made with regard to numerous other substances employed in medicine or in the arts, and it is quite obvious that difficulties of this kind, can only be properly met by those practitioners who have closely attended to the subject of toxicology. It is well known that bodies which are not in their own nature destructive, may become so through indirect causes. Metallic iron is not a poison, nor can it, except under certain circumstances, be regarded as a destructive thing. An angular mass of iron may, however, kill by perforating the viscera; or, if the metal be exhibited in the state of filings, in large doses frequently repeated, then it may become a source of irritation in the stomach, and lead to ulceration and perforation. There will be no difficulty, however, for a practitioner to form an opinion in this and all similar cases. For an interesting case showing how death may be produced by these mechanical bodies, see Med. Gaz. xxxv. 885. A boy, ten years of age, was destroyed by hæmorrhage from the stomach, a month after he had swallowed a copper coin.

Among the singular methods resorted to for the purpose of destroying the lives of infants and children, that of causing them to swallow pins or needles in their food, is one which claims the attention of medical jurists. This mode of perpetrating murder has been brought to lihgt by the evidence given on several criminal trials, which have

taken place of late years in England and on the continent. In cases of this kind, death is commonly to be referred to inflammation: and a practitioner can have no hesitation in designating these bodies, when exhibited to young children, as "destructive things:" they are at all times likely to lead to serious injury, if not to death; nor is it any answer to this view to assert, that they have been often swallowed with impunity. We know that active poisons are sometimes taken without causing death; but this does not alter our opinion of their being substances destructive to life, and likely to give rise to the most serious consequences. A case is reported in the Medical Gazette (vol. xxvi. p. 582) which will show how far the powers of nature are sometimes capable of resisting the effects of these mechanical irritants. Here it appears that two hundred and fifty-four pins and needles were removed from a female aged 23, in whose body the greater number had remained for a period of thirteen years. That death may ensue from this cause, is an undoubted fact. In the Registrar's report for 1838–9, one child is stated to have died from the effects produced by swallowing a pin. In August, 1841, a boy aged eleven years was committed to Newgate on a charge of theft. Shortly after his imprisonment, he swallowed a quantity of pins for a trifling wager. He soon afterwards became extremely ill, and died in the course of a few weeks, evidently from the effects of the mechanical irritant which he had swallowed.

It is obvious that the fatal effects thus induced by pins or needles must be in a great measure accidental. It is not from the number of these articles swallowed, nor from the age of the subject, that any just inference can be drawn as to the probability of their proving fatal to life. If it be true, as M. Ollivier has asserted, that death is the exception to the rule, it is not the less true, that the life of any individual who has swallowed pins or needles is always in danger until they are discharged. Sometimes, in these cases, life may be suddenly destroyed by hæmorrhage. Mr. Bell has published a case in which a young man aged 18 accidentally swallowed a needle in soup. In the course of ten days, he had several attacks of spitting of blood, and in one of these fits he vomited a large quantity, and expired in a few minutes. On examination, a fine sewing needle was found lying across the œsophagus, the point of which had penetrated the right common carotid artery, and had led to the fatal hæmorrhage.—(Med. Gaz. xxxi. 694.) For a very ingenious method of detecting needles in the body when buried beneath the skin I must refer, to a pamphlet by Mr. A. Smee, London, 1845. That a medical jurist must be prepared for giving evidence on the effects of mechanical irritants will be proved by the following case, which came to a trial on a charge of murder at the Chelmsford Assizes in 1835.

The prisoner, an old woman, was indicted for the murder of her granddaughter, by causing her to swallow some sponge and a piece of wood. It was also suspected that she had administered pins to the child. The deceased

was eleven weeks old ; and until within a very short period of its death, it had appeared to enjoy very good health. The evidence of the only medical witness examined, was to the following effect. He stated, that on a post-mortem examination of the body of the child, he had found the mucous membrane of the stomach inflamed as well as the liver, and there were adhesions of the peritoneum. The stomach contained a piece of wood, and there were several pieces of sponge in the large intestines. On inspecting the viscera more closely, he discovered a pin in the substance of the liver, on its convex surface next the stomach. The pin was discoloured by the fluids of the body. The substances which he found in the body were sufficient to produce inflammation ; and it was in his judgment, this inflammation that had caused the death of the child. The witness could give no opinion as to how the pin had penetrated into the liver. On cross-examination, he admitted that the pin might have found its way into the cavity of the abdomen by accident. The wood and sponge might also have been accidentally introduced during the dressing and feeding of the child. It was left to the jury to say, whether the substances found in the viscera, and which by mechanical irritation had led to inflammation and death, had been introduced wilfully or accidentally, and as there was no direct evidence on this point, they acquitted the prisoner.

In this case, the mechanical irritation was probably as much due to the sponge as to the pin. The quantity of sponge found within the intestines was small. It is difficult to conceive how these different substances could have been accidentally swallowed by an infant.

Sponge may be regarded as a mechanical irritant; but little is known concerning its action on a human being. In the Medical Gazette (vol. xxxi. p. 124), two cases are related in which this substance was swallowed by a horse. In one case, it did not appear that the animal suffered any inconvenience ; but in the other case, it became alarmingly ill. There can be but little doubt, that where sponge in large quantity remains lodged in the viscera, it is capable of producing inflammation and death. Dr. Chowne has, however, lately reported a case in which a small piece of sponge accidentally swallowed by an infant, produced no injurious effect. Among mechanical irritants, there yet remains to be mentioned one, which was formerly regarded as an active poison, namely, *pounded glass*. Recent observations have satisfactorily shown, that this substance is not a poison. It is liable to inflict injury upon the alimentary canal, just in proportion to the size and sharpness of the fragments; and whenever it is swallowed in a state of coarse powder, it may irritate and excite inflammation of the stomach and bowels.

Glass, in very fine powder, is decidedly alkaline ; but it does not possess any of the properties of an alkaline poison :—on the contrary, in that condition in which its alkalinity is most manifested, it appears to be inert. It is said, that six or seven ounces of this substance have been given to a dog without producing any inconvenience to the animal. A trial for murder occurred in Paris in 1808, in which the accused was charged with having poisoned his wife by administering to her pounded glass. This substance was found in the stomach, and both this organ and the intestines exhibited marks of great irritation. Baudelocque and Chaussier gave their opinion that the

glass was not the cause of death. Portal relates an instance of a young man who during a debauch broke a glass between his teeth, and then swallowed some of the fragments. These were afterwards expelled by active vomiting, and he recovered. In an attempt made by an ignorant person some years since to poison a whole family with coarsely powdered bottle-glass mixed with food,—no inconvenience resulted to those who had swallowed a portion of the glass. A case is, however, reported in which it appears highly probable that a child aged eleven months was killed by the administration of this substance. Powdered glass was found in the mucus of the stomach and the lining membrane itself was very vascular.—(Christison, 654.) It is obvious that a substance of this description cannot be easily swallowed by an adult, without his being perfectly aware of it; and the instances in which it has been administered to infants are very few in number. Although I believe the only instance reported of its having acted fatally is in the case of the infant just described; yet a medical jurist cannot hesitate to say that pounded glass is a mechanical irritant, and that the irritation caused by the presence of a large quantity of this substance in the stomach or bowels, might lead to fatal gastritis or enteritis. For a highly interesting case in which a medico-legal question was raised on the effects of pounded glass and mechanical irritants generally, see Annales D'Hyg., 1830, i. 364. Experiments on this subject have been recently performed by Dr. Rufz. (AnnalesD'Hyg., 1844, ii. 195.)

Some toxicologists have placed hot liquids, such as *boiling water* or *oil*, in the class of mechanical irritants; but the action of such liquids cannot with propriety be said to be mechanical. They do not act like poisons, although they leave in the body, changes similar to those produced by corrosive poisons. Death from the accidental swallowing of boiling water, is by no means uncommon among young children. According to the observations of Dr. Hall and Mr. Ryland, death is most commonly to be ascribed to inflammation of the fauces and larynx, produced by the contact of a boiling liquid. This inevitably leads to suffocation, unless assistance be at hand. In a case of recent occurrence, March, 1845, a child was actually asphyxiated from this cause when my friend, Mr. E. Cock, by the timely performance of tracheotomy and inflation of the lungs, succeeded in restoring it. Sometimes, however, inflammation of the stomach is a consequence. A case of this kind occurred a few years since at Guy's Hospital, and on a post-mortem examination, the mucous membrane at the larger end of the stomach was found to be much inflamed. The appearance was very like that produced by the common mineral irritants, although it was more confined to one part of the mucous membrane. In the Registrar's report for 1838–9, twenty-four deaths are stated to have occurred among young children from this cause alone.

In concluding this chapter, it may be proper to say a few words on the influence of *habit* and *idiosyncrasy*, in relation to poisons, as these terms are frequently employed in medico-legal cases of poisoning.

HABIT, it is well-known, diminishes the effect of certain poisons :—thus it is that opium, when frequently taken by a person, loses its effect after a time, and requires to be administered in a much larger dose. Indeed, confirmed opium eaters have been enabled to take at once, a quantity of the drug which would have infallibly killed them, had they commenced with it in the first instance. For a remarkable case illustrative of the influence of habit in diminishing the effects of strychnia, see Med. Gaz, xxxvi. 261. The patient finally took, without injury, three grains a day for six days. Dr. Christison has remarked that this influence of habit is chiefly confined to poisons derived from the organic kingdom ; and I quite agree with him, in thinking that the stories related of arsenic-eaters, and corrosive-sublimate eaters, are not to be credited. There is no proof that any human being has ever accustomed himself, by habit, to take these substances in doses that would prove poisonous to the generality of adults. The only form in which I have known the question of habit to be raised in medical jurisprudence is this : whether while the more prominent effects of the poison are thereby diminished, the insidious or latent effects on the constitution are at the same time counteracted. The answer is of some importance in relation to the subject of life-insurance :—for the concealment of the practice of opium-eating by an insured party has already given rise to an action, in which medical evidence on this subject was rendered necessary. As a general principle, we must admit that habit cannot altogether counteract these insidious effects of poisons ; but that the practice of taking them, is liable to give rise to disease or impair the constitution.

IDIOSYNCRASY differs from habit :—it does not, like this last, diminish the effect of a poison : for it is not found that any particular state of body is a safeguard against the effects of these powerful agents. Some constitutions are observed to be much more affected than others by certain poisons ;—thus opium, arsenic, and mercury, are substances of this description, and this difference in their effects, is ascribed to idiosyncrasy. Again, certain substances generally reputed harmless, and indeed used as articles of food, are observed to affect some persons like poisons. This is the case with pork and certain kinds of shell-fish. There may be nothing poisonous in the food itself ; but it acts as a poison in particular constitutions :—whether from its being in these cases a poison *per se*, or rendered so during the process of digestion, it is difficult to say. The subject of idiosyncrasy is of great importance in a medico-legal view, when symptoms resembling those of poisoning follow a meal on a particular kind of food. In such a case, without a knowledge of this peculiar condition, we might hastily attribute to poison, effects which were really due to another cause.

CHAPTER II.

ON THE CLASSIFICATION OF POISONS.

Poisons may be divided into three classes, according to their mode of action on the system, namely, Irritants, Narcotics, and Narcotico-Irritants. This classification is a modification of that originally proposed by Orfila; and is almost universally adopted by toxicologists.

The Irritants are possessed of these common characters. When taken in ordinary doses, they occasion speedily violent vomiting and purging. These symptoms are either accompanied or followed by intense pain in the abdomen. The peculiar effects of the poison are manifested chiefly on the stomach and intestines, which, as their name implies, they irritate and inflame. Many substances belonging to this class of poisons, possess corrosive properties, such as the strong mineral acids, caustic alkalies, bromine, corrosive sublimate and others. These, in the act of swallowing, are commonly accompanied by an acrid or burning taste, extending from the mouth down the œsophagus to the stomach. Some irritants do not possess any corrosive action,—of which we have examples in arsenic, the poisonous salts of barytes, carbonate of lead, cantharides, &c., and these are often called pure irritants. They exhibit no chemical action on the tissues with which they come in contact; they simply irritate and inflame them. There is this difference between Corrosive and Irritant poisons. Under the action of corrosive poisons, the symptoms are commonly manifested immediately, because mere contact produces disorganization of a part, usually indicated by some well-marked symptoms. In the action of the purely irritant poisons, the symptoms are generally more slowly manifested, seldom showing themselves until at least half an hour has elapsed from the time of swallowing the substance. Of course, there are exceptions to this remark; for sometimes irritants act speedily, though seldom with the rapidity of corrosive poisons. It is important, in a practical view, to distinguish whether in an unknown case, the poison which a person requiring immediate treatment, may have swallowed, be irritant or corrosive. This may be commonly determined by the answer to the question, as to the time at which the symptoms appeared after the suspected substance was taken. In this way we may often easily distinguish between a case of poisoning from arsenic and one from corrosive sublimate. There is also another point which may be noticed. As the corrosion is due to a decided chemical action, so an examination of the mouth and fauces may enable us to determine the nature of the poison swallowed.

It has been already stated that there are many irritant poisons which have no corrosive properties; and therefore never act as corrosives: but it must be remembered that every corrosive may act as an irritant. Thus the action of corrosive sublimate is that of an irritant poison, for

while it destroys some parts of the coats of the stomach and intestines, it irritates and inflames others. So again most corrosive poisons may lose their corrosive properties by dilution with water, and then they act simply as irritants. This is the case with the mineral acids, and bromine. In some instances, it is not easy to say whether an irritant poison possesses or not corrosive properties. Thus oxalic acid acts immediately, and blanches the mucous membrane of the mouth and fauces, but I have never met with any decided marks of what could be called chemical corrosion produced by it in the stomach or viscera. Irritant poisons, for the most part, belong to the mineral kingdom; and they may be divided into the non-metallic and metallic irritants. There are a few derived from the animal and vegetable kingdom; but these are not very often employed criminally. Some of the gases likewise belong to the class of irritant poisons.

NARCOTIC poisons have their operation confined to the brain and spinal marrow. Either immediately or some time after the poison has been swallowed, the patient suffers from cephalalgia, vertigo, paralysis, coma, and in some instances tetanus. They have no acrid burning taste like the corrosive irritants; and they very rarely give rise to vomiting or diarrhea. When these symptoms follow the ingestion of the poison into the stomach, the effect may be perhaps ascribed either to the quantity in which the poison has been taken, and the mechanical distension of the stomach thereby produced, or to the poison being combined with some irritating substance, such as alcohol. The pure narcotics are commonly said not to irritate or inflame the viscera.

Notwithstanding the well-defined boundary thus apparently existing between these two classes of poisons, it must not be supposed that each class of bodies will always act in the manner indicated. Some irritants have been observed to affect the brain or the spinal marrow remotely. This is the case with oxalic acid and arsenic. Both of these common poisons have in some instances given rise to symptoms closely resembling those of narcotic poisoning; namely, coma, paralysis, and tetanic convulsions; and on the other hand, prussic acid has been known to produce vomiting, and to cause an inflammatory redness of the mucous membrane of the stomach, closely resembling the effects produced by irritant poisons. Thus, then, we must not allow ourselves to be deceived with the idea that the symptoms are always clearly indicative of the kind of poison taken. The pure narcotic poisons are few in number, and belong to the vegetable kingdom. Some of the poisonous gases possess a narcotic, others an irritant action.

NARCOTICO-IRRITANTS.—Poisons belonging to this class have, as the name implies, a compound action. They are all derived from the vegetable kingdom. At variable periods after being swallowed, they give rise to vomiting and diarrhea like irritants; and sooner or later produce stupor, coma, paralysis and convulsions, owing to their effect on the brain and spinal marrow. They possess the property, like irritants, of irritating and inflaming the alimentary canal. As familiar examples we may point to nux vomica, monkshood and poisonous mushrooms.

This class of poisons is very numerous, embracing a large variety of well-known vegetable substances; but they rarely form a subject of difficulty to a medical practitioner. The fact of the symptoms occurring after a meal at which some suspicious vegetables may have been eaten, coupled with the nature of the symptoms themselves, will commonly indicate the class to which the poison belongs. Some narcotico-irritants have a hot acrid taste, such as the aconite or monkshood.

I here subjoin tables of the more important poisons, with the properties of which it is necessary for a medical jurist to be acquainted. Poisons are divided into three classes. 1. Irritants. 2. Narcotics, and 3. Narcotico-Irritants. The class of Irritants may be thus subdivided:—

1. Irritants. { Mineral. { Non-metallic. / Metallic. / Vegetable. / Animal.

Class 1.

1. Non-metallic Irritant Poisons.—Sulphuric acid. Sulphate of indigo. Nitric acid. Muriatic acid. Nitromuriatic acid. Nitro-sulphuric acid. Oxalic acid.* Tartaric acid. Binoxalate of Potash. Bitartrate of potash. Acetic acid. Potash and its carbonates. Soda and its carbonates. Ammonia and its carbonate. Iodide of potassium. Sulphurets of potassium and sodium. Nitrate of potash. Sulphate of potash. Alum. Barytes and its salts. Phosphorus. Phosphoric acid.

2. Metallic Irritant Poisons.—Arsenic. Arsenite of potash. Arsenic acid. Orpiment. Corrosive sublimate. Calomel. White precipitate. Red oxide of mercury. Turbith mineral. Vermilion. Cyanide of mercury. Nitrates of mercury. Lead and its salts. Copper and its salts. Tartarized antimony. Butter of antimony. Chlorides of tin. Salts of zinc. Nitrate of silver. Sulphate of iron. Muriate of iron. Subnitrate of bismuth. Bichromate of potash.

3. Vegetable Irritant Poisons.—Aloes. Colocynth. Gamboge. Jalap. Scammony. Savin. Croton oil. Castor-oil seeds. Berries of the yew. Cayenne pepper. Oil of tar.

4. Animal Irritant Poisons.—Cantharides. Poisonous articles of food.

Class 2.

Narcotic Poisons.—Hyoscyamus. Lactuca. Solanum. Opium, and its preparations. Morphia, and its salts. Hydrocyanic acid. Oil of bitter almonds. Laurel water. Cyanide of potassium.

* The Oxalic, Tartaric and Acetic acids, which really belong to the vegetable kingdom, are placed among the non-metallic mineral irritants from the analogy which they bear to these poisons in their effects.

Class 3.

Narcotico-Irritant Poisons.—Nux Vomica. Strychnia. Colchicum. Veratria. White hellebore. Digitalis. Conium. Cicuta. Æthusa cynapium. Œnanthe crocata. Datura stramonium. Aconitum napellus. Atropa belladonna. Nicotiana tabacum. Cocculus indicus. Cytisus laburnum. Fungi. Camphor. Alcohol.

The selection here made has been chiefly confined to those bodies which have either caused death or given rise to serious accidents.

CHAPTER III.

ON THE RULES TO BE OBSERVED IN INVESTIGATING A CASE OF POISONING.

When a practitioner is called to a case of poisoning, it is above all things necessary that he should know to what points he ought to give his attention. It is very proper that every effort should be made by him to save life where the individual is still living: but while engaged in one duty, it is also in his power to perform another, supposing the case to be one of suspected criminal poisoning,—namely, to note down many circumstances which may tend to detect the perpetrator of the crime. There is no person so well fitted to observe these points as a medical man; but it unfortunately happens, that many facts important as evidence, are often overlooked. The necessity for observing and recording them, is not perhaps generally known. The following appear to me to be the principal points which demand the attention of a medical jurist in all cases of suspected poisoning:—1. With respect to

Symptoms.—1. The time of their occurrence,—their nature. 2. The exact period at which they were observed to take place after a meal, or after food or medicine had been taken. 3. The order of their occurrence. 4. Whether there was any remission or intermission in their progress, or, whether they continued to become more and more aggravated until death. 5. Whether the patient had laboured under any previous illness. 6. Whether the symptoms were observed to recur more violently after a particular meal or after taking any particular kind of food or medicine. 7. Whether the patient has vomited:—the vomited matters, if any, (especially those first ejected,) to be procured:—their colour noted,—as well as their quantity. 8. If none be procurable, and the vomiting have taken place on the dress, furniture, or floor of the room,—then a portion of the clothing, sheet, or carpet, may be cut out and reserved for analysis:—if the vomiting have occurred on a deal floor, a portion of the wood may be scraped or cut out:—or if on a stone pavement, then a clean piece of rag or

sponge soaked in distilled water may be used to remove any traces of the poison. [Some years since, an animal was poisoned by arsenic. None of the poison could be detected in the stomach, but it was easily found in a portion of deal floor, rendered humid by the liquid matters which the animal had vomited during the night.] 9. Endeavour to ascertain the probable nature of the food or medicine last taken. 10. Ascertain the nature of *all* the different articles of food used at a meal. 11. Any suspected articles of food, as well as the vomited matters, to be sealed up in a proper vessel and reserved for analysis. 12. Note down in their own words, all explanations voluntarily made by parties present, or who are supposed to be concerned in the suspected poisoning. 13. Whether more than one person partook of the food or medicine:—if so, whether all these persons were affected, and how. 14. Whether the same kind of food or medicine had been taken before by the patient or other persons without ill effects following. In the event of the *death* of the patient, it will be necessary for a practitioner to note down—15. The *exact time* of death, and thus determine how long a period the person has survived after having been first attacked with the symptoms. 16. Observe the attitude and position of the body. 17. Observe the state of the dress. 18. Observe all surrounding objects. Any bottles, paper packets, weapons, or spilled liquid lying about, should be collected and preserved. 19. Collect any vomited matters near the deceased. Observe whether vomiting has taken place in the recumbent position or not. If the person have vomited in the erect or sitting posture, the front of the dress will commonly be found covered with the vomited matters. In the event of a *post-mortem examination* being ordered by a coroner—20. Note the external appearances of the body, whether the surface be livid or pallid. 21. Note the state of the countenance. 22. Note all marks of violence on the person or discomposure of the dress,—marks of blood, &c. 23. Observe the presence or absence of warmth or coldness in the legs, arms, abdomen, mouth, or axillæ. 24. The presence of rigidity or cadaverous spasm in the body. To give any value to the two last-mentioned characters, it is necessary for the practitioner to observe the nature of the floor on which the body is lying, whether it be clothed or naked, young or old, fat or emaciated. All these conditions create a difference, in respect to the cooling of the body and the access of rigidity. 25. If found dead—When was the deceased last seen living or known to have been alive? 26. Note all circumstances leading to a suspicion of suicide or murder.

Inspection of the Body.—27. The time after death at which the inspection is made. 28. Observe the state of the abdominal viscera. If the stomach and intestines be found inflamed, the seat of inflammation should be exactly specified; also all marks of ulceration, effusion of blood, corrosion, or perforation. 29. The contents of the stomach should be collected in a clean graduated vessel:—notice *a* the quantity, *b* the odour tried by several persons, *c* the colour, *d* acid or

alkaline reaction. *e* presence of blood, mucus, or bile, *f* presence of undigested food, *g* other special characters:—30. The contents of the duodenum should be separately collected. 31. Observe the state of the large intestines, especially the rectum. 32. The state of the larynx, fauces, and œsophagus, whether there be in these parts any marks of inflammation or corrosion. 33. The state of the thoracic viscera:—all morbid changes noted. 34. The state of the brain.

Such are the points to which, in the greater number of cases of suspected poisoning, a medical jurist should attend. By means of these data, noted according to the particular case to which they are adapted, he will in general be enabled, without difficulty, to determine the probable time of death, the probable cause of death, and the actual means by which death was brought about. He may thereby have it in his power also to point out the dish which had contained the poison, if the case be one of poisoning; and to throw some light upon any disputed question of suicide or murder in relation to the deceased. Many cases of poisoning are obscure, owing to these points not having been attended to in the first instance.

It is necessary to observe, that all legal authorities rigorously insist upon proof being adduced of the *identity* of the vomited matters or other liquids taken from the body of a deceased person, when poisoning is suspected. Supposing that during the post-mortem examination, the stomach and viscera are removed from the body, they should never be placed on any surface or in any vessel until we have first ascertained that the surface or vessel is perfectly *clean*. If this point be not attended to, it will be in the power of counsel to raise a doubt in the minds of the jury, as to whether the poisonous substance might not have been accidentally present in the vessel used. This may be regarded as a very remote presumption; but nevertheless, it is upon technical objections of this kind, that acquittals follow in spite of the strongest presumptions of guilt. This is a question for which every medical witness should be prepared, whether he be giving his evidence at a coroner's inquest, or in a court of law. Many might feel disposed to regard matters of this kind as involving unnecessary nicety and care; but if they be neglected, it is possible that a case may be at once stopped, so that any care bestowed upon the chemical analysis by the practitioner, will thus have been thrown away. Evidence of the presence of poison in the contents of a stomach was once rejected in a court of law, because they had been hastily thrown into a jar borrowed from a neighbouring grocer's shop; and it could not be satisfactorily proved that the jar was clean and entirely free from traces of poison (in which the grocer dealt) when used for this purpose. When the life of a human being is at stake, as in a charge of murder by poisoning, the slightest doubt is always very properly interpreted in favour of a prisoner.

Not only must clean vessels be used for receiving any liquid destined for subsequent chemical analysis; but care must be taken by the

practitioner that the identity of a substance is preserved, or the most correct analysis afterwards made, will be inadmissible as evidence. The suspected substance, when once placed in his hands, should never be let out of his sight or custody. It should be kept sealed under his private seal, and locked up while in his possession. If he has once let it out of his hands, and allowed it to pass through the hands of several other persons, then he complicates the evidence for the prosecution, by rendering it indispensable for these parties to state under what circumstances it was placed, while in their possession. The exposure of a suspected substance on a table, or in a closet or room, where many have access, may be fatal to its identity; for the chemical evidence, so important in a criminal investigation, will probably be altogether rejected by the court. A few years ago, a case was tried on the Norfolk circuit, in which the analysis of the matters vomited by a person poisoned by arsenic, was not admitted as evidence against the prisoner, because the practitioner had left them in the keeping of two ignorant women; and these women had allowed the vessel containing the suspected liquid (which was proved to contain arsenic) to be exposed in a room open to the access of many persons. In another case, tried at the Old Bailey sessions in 1835, the analysis of some suspected liquids was not allowed in evidence, because the practitioner, who lived in the country, and was unwilling to take upon himself the responsibility of analysing them, had sent them up to town by a carrier, to be examined by a London chemist. If closely sealed by a private seal, and this be observed by the receiver to be unbroken, before he proceeds to the analysis—this mode of transmission, will not probably be objected to.

It has already been recommended as a rule in these criminal investigations, that a practitioner should make notes of what he observes in regard to symptoms, post-mortem appearances, and the results of a chemical analysis. From the common forms of law in this country, an individual charged with the crime of poisoning may remain imprisoned, if at a distance from the metropolis, for some months before he is brought to trial. It is obvious, however clear the circumstances may at the time appear to the examiner, that it will require more than ordinary powers of memory to retain for so long a period, a distinct recollection of all the facts of the case. If he be unprovided with notes, and his memory be defective, then the case will turn in favour of the prisoner, for he will be the party to benefit by the neglect of the witness. In adopting the plan here recommended, such a result may be easily prevented. It may be remarked, that the law relative to the admissibility of notes or memoranda in evidence, is very strict, and is rigorously insisted on by the judges. In order to render such notes or memoranda admissible, it is indispensably necessary that they should be taken on the spot at the time the observations are made, or as soon afterwards as practicable. It is not necessary to their admissibility as evidence, that

the observations should be written down by the practitioner himself, provided they are made under his immediate inspection at the time, or at his suggestion, and are soon afterwards looked over and corrected by him. Thus, whenever, at a trial, a medical witness produces notes for reference during his examination, the question is invariably put to him as to when the notes were made. Their admissibility depends upon his answer.

Many examples might here be cited of the rejection of notes, made by medical witnesses, owing to a non-observance of these points. On the trial of *Sir A. Gordon Kinloch* at Edinburgh, for the murder of his brother, the surgeon was about to give his evidence respecting the wound of which the deceased had died, from notes made some time after the event, when he was stopped by the judge, who explained to him the law on the subject. The reason why the law so rigorously excludes the admission of memoranda in evidence, made at a distance of time, appears to be this: it prevents the possibility of all fraud or collusion on the part of the witnesses, either to favour or injure the prisoner; for a connected story might, it is presumed, by such means be so made up at a distance of time, as to defy the ingenuity of counsel on either side to make out the deceit. The notes used by a witness should be original, and not a copy of notes made by another. A copy of notes, except under very peculiar circumstances, is not admissible as evidence.

There is another rule of law with respect to the use of notes or memoranda in evidence, which is not perhaps so generally known to medical practitioners; but it is essential that it should be observed. The notes may have been fairly made on the spot in the manner required by law; but when a witness is about to refer to them, he will probably be asked whether he is using them for the purpose of refreshing his memory, or whether he is about to speak only from what is written on the paper, without having any precise recollection on the subject. If he is referring to them for some fact which he has altogether forgotten, then the notes are pro tanto inadmissible as evidence; for it has been held by our judges, that notes can only be used in evidence for the purpose of refreshing the memory on a fact *indistinctly remembered:* they are not permitted to be used for the purpose of reviving impressions entirely forgotten. The most eminent legal writers lay it down, that if there be any single point in the notes, which the witness does not recollect, except that he finds it there written, such point is not evidence. Notes are only allowed to assist recollection, not to convey information.

On a late trial for poisoning, the medical witness, after having detailed the action of some tests, which he had employed in the detection of the poison, referred to his notes before giving the results of other experiments. Upon being asked when the notes were made, he answered satisfactorily by stating, that they were taken at the time of the observations. The counsel then asked the witness, whether he

used the notes to refresh his memory, or whether he had forgotten the subject, and was about to speak only from what was written on the paper. The witness said, that his memory was bad; that some time had elapsed, and he had entirely forgotten the results of these experiments. It was then objected that the results could not be given in evidence, since the witness could only speak to the facts from the memorandum which he held in his hand. The objection was admitted by the judge, and the evidence from the analysis was rejected. The reason for a rigorous adherence to this rule of law is not very apparent. In applying it to medical evidence, it must often operate in such a way, as to give an undue advantage to a criminal. Many witnesses who are summoned to give evidence in courts of law, are not much accustomed to the analysis of poisons; and probably may never have performed the usual experiments, until that particular case occurred to draw their attention to the subject. It is well known to practised analysts, that numerous tests are required to show what a suspected substance is, as well as what it is not;—that the action of these tests is sometimes attended with results not easily remembered; and it can be no imputation upon those who are less practised in toxicology, that they should not be able to retain for many months together, the whole of the results of such experiments. We might suppose that the making of a record at the time would be sufficient to render the evidence admissible; nor does it appear how the adoption of such a rule could ever injure a really innocent person. From the rejection of notes on this ground in the case above quoted, it would seem that good medical evidence, to be available in a court of law, must in many cases depend upon the accidental possession of an excellent memory by the witness. But many men, equally well informed and fitted to act as witnesses, are not equally endowed with this faculty. If justice cannot be safely administered without enforcing such a rule, then it follows, that only those persons who have powerful memories should be selected to act as witnesses. But on the other hand, with an excellent memory, there may not be that mental capacity which renders a man well fitted for observing those medical facts from which good evidence must always be drawn. These remarks on the taking of notes, and the method of using them in a court of law, have here been made in reference especially to cases of criminal poisoning; since they are, perhaps, more frequently required in these, than in other medico-legal cases. It will be understood, however, that they apply with equal force to every medico-legal investigation in which the practitioner may be concerned.

CHAPTER IV.

ON THE EVIDENCE OF POISONING IN THE LIVING SUBJECT.

This inquiry becomes necessary in every case, where a person is charged with having administered poison with intent to murder; but from the effects of which the patient ultimately recovers. A knowledge of the symptoms produced during life, is also an important part of evidence, in those cases in which the poison proves fatal. At present, however, we will suppose the case to have been that poison has been taken and the patient survives. Most toxicological writers have laid down certain characters whereby it is said symptoms of poisoning may be distinguished from those of disease.

1. In poisoning, the symptoms appear suddenly, while the individual is in health.—It is the common character of most poisons, when taken in the large doses in which they are usually administered with criminal intent, to produce serious symptoms either immediately or within a very short period after they have been swallowed. Their operation, under such circumstances, cannot be suspended, and then manifest itself after an indefinite interval; although this was formerly a matter of universal belief, and gave rise to many absurd accounts of what was termed *slow* poisoning. In modern times, the negroes of Martinique have been said to possess this art, but the late interesting researches of Dr. Rufz show that this is an erroneous statement.—(Annales D'Hygiène, 1844, i. 392; also ii. 170.) It is very true, that these powerful agents, given at intervals in small doses, do not cause those striking symptoms upon which a practitioner commonly relies as evidence of poisoning. They may then produce disorder, but of so slight a nature, as scarcely to excite suspicion. Again, there are what are called *accumulative* poisons,—substances which, in small divided doses, given at long intervals, produce scarcely any perceptible effect on the system; but which appear to accumulate in the body, and at some unexpected time, their power is manifested with sudden and violent energy. To these forms of poisoning, which it is extremely rare to meet with on criminal charges, the characters about to be described are not applicable.

When poison is criminally administered, it is almost always in such doses as to cause the symptoms to appear *suddenly* and to run their course with great rapidity. The symptoms of poisoning by prussic acid, oxalic acid, or strychnia, appear immediately, or within a very

few minutes after the poison has been swallowed. In one case, however, where the dose of prussic acid was small, and insufficient to produce death, the poison was supposed by the patient not to have begun to act until after the lapse of fifteen minutes.—(Ed. Med. and Surg. J., lix. 72.) The symptoms caused by arsenic and other irritants, and, indeed, by all poisons generally, are commonly manifested in from half an hour to an hour. It is rare that the appearance of the symptoms is protracted for two hours, except under certain peculiar states of the system. It is said, that some narcotico-irritant poisons, such as the poisonous mushrooms, may remain in the stomach twelve or twenty-four hours without giving rise to symptoms; and this is also affirmed to be the case of some animal irritants, such as decayed meat; but with regard to the first point, it has been shown by Dr. Peddie, that mushrooms may produce symptoms in half an hour; and a case has fallen under my own observation, where the symptoms from noxious food came on within as short a time after the meal, as is commonly observed in irritant poisoning by mineral substances. In cases of poisoning by phosphorus, the symptoms do not commonly begin until after the lapse of many hours. (See PHOSPHORUS, post.)

It is necessary to remark, that the symptoms produced by some of the most common poisons, are apt to be retarded under certain conditions of the system. When an irritant poison is taken on a full stomach, the symptoms do not commonly appear so speedily as when the stomach is empty. So again, it is stated by Dr. Christison, from cases which have fallen under his notice, that *sleep* retards the action of arsenic, and the same may hold with other irritants. Thus, if the patient should happen to fall asleep soon after swallowing the poison, it may not produce the usual symptoms until four or five hours afterwards, or the occurrence of these may be even longer protracted. This is supposed to be owing to the general state of insensibility of the body, and the depressed condition of the nervous system during sleep.

Intoxication has been considered to retard the operation of opium. Observations of this kind must, of course, be accidental; and there is scarcely a sufficient number of cases reported of narcotic poisoning under these circumstances, to justify a decided opinion on the point. It was observed of a person who had swallowed a strong dose of opium, while partially intoxicated, that the symptoms were some hours before they were manifested. Perhaps, strictly speaking, the symptoms in these cases are masked. Dr. Christison remarks, what is no doubt the fact, that a *diseased* state of the body may render a person comparatively insusceptible of the action of some poisons. In dysentery and tetanus, a person will take, without being materially affected, a quantity of opium sufficient to kill an adult in average health. Mania, cholera, hysteria, and delirium tremens, are also diseases in which large doses of opium may be borne. In a case of hemiplegia, a woman, æt. 29, took for six days three grains of strychnia daliy without injurious consequences—the dose having been gradually

raised. (Gaz. Méd. Mai, 1845.) One grain of strychnia is commonly regarded as a fatal dose to a healthy person. The effect of these diseases, as well as of habit, either in retarding the appearance of symptoms, or in blunting the operation of a poison, it is not difficult to appreciate; and they are cases which can present no practical difficulty to a medical jurist. On the other hand, in certain diseased states of the system, there is an increased susceptibility to the action of poison. Thus, in those persons who have a tendency to apoplexy, a small dose of opium may act more quickly and prove fatal. In a person labouring under inflammation of the stomach or bowels, there would be an increased susceptibility to the action of arsenic or other irritants. Indeed it may be safely affirmed, that wherever the body is much debilitated by disease, poisons acquire greater virulence of action. A most absurd degree of importance appears to have been attached to this modifying condition, in *Tawell's* case, (Bucks Lent assizes, 1845). It was, as I am informed, alleged that epilepsy would increase the effects of prussic acid. In the accident which occurred to the seven Parisian epileptics, on which so much stress was laid in the defence, one man died in about twenty minutes, and another lived three quarters of an hour, although all took the *same dose,* which it was afterwards contended was unusually large. These facts are obviously of some importance in relation to those cases where the party who has taken the poison, is already in a diseased or exhausted state. Thus, then, there are but few exceptions to the rule laid down, that the symptoms of poisoning are liable to appear suddenly; and that in most cases they are commonly manifested within an hour. Then, again, it is said, symptoms of poisoning appear in a person while in a state of *perfect health,* without any apparent cause. This rule is, of course, open to numerous exceptions, because the person on whose life the attempt is made may be actually labouring under disease; and under these circumstances, the symptoms of poisoning are so obscure as often to disarm all suspicion. In the case of *Mrs. Smith,* who was poisoned by orpiment in 1835, it was the fact of the deceased having laboured under general illness for some time before death, that prevented any suspicion from being fixed on the prisoner Burdock, who attended her as a nurse. When poison is exhibited in medicine, a practitioner is very liable to be deceived, especially if the disease under which the party is labouring be of an acute nature, and attended by symptoms of disorder in the alimentary canal. Several cases of poisoning have occurred within the last few years, where arsenic was criminally substituted for medicine, and given to the parties while labouring under a disorder of the bowels.

Thus, then, it may be said with respect to this criterion, that where in a previously healthy person symptoms resembling those of poison occur suddenly and without any assignable cause, such as disease or indiscretion in diet, to account for them, there is strong reason to suspect that poison has been administered. When the party is already labouring under disease, we must be especially watchful on the occur-

rence of any sudden change in the character or violence of the symptoms, unless such change can be easily accounted for on common and well-known medical principles. In most cases of criminal poisoning, we meet with alarming symptoms without any obvious or sufficient cause to explain them. The practitioner is of course aware that there are certain diseases which are liable to occur suddenly in healthy people, the exact cause of which may not at first sight be apparent; therefore this criterion is only one out of many on which a medical opinion should be founded. Some have said that the symptoms of poisoning are characterized by a *regularity* of increase, or by becoming more and more aggravated as the case advances; but this is a weak criterion. In the operation of most of the active irritants, there are often remissions, and occasionally intermissions of pain, so as to give rise to a false hope of recovery. The character of the symptoms is sometimes suddenly changed; vomiting may cease, and may be succeeded by coma. While, then, on the one hand, such a case might, by trusting to this criterion, be regarded as one rather of disease than of poisoning; there are, on the other, certain diseases which are very rapid and violent in their progress, and the symptoms of these might, for the same reason, be mistaken for those of poisoning.

2. IN POISONING, THE SYMPTOMS APPEAR SOON AFTER A MEAL, OR SOON AFTER SOME KIND OF FOOD OR MEDICINE HAS BEEN TAKEN. —This is by far the most important character of poisoning in the living body. It has been already observed, that most poisons begin to operate within about an hour after they have been swallowed; and although there are some few exceptions to this remark, yet they occur under circumstances easily to be appreciated by a practitioner. Thus, then, it follows, that, supposing the symptoms under which a person is labouring, to depend on poison, the substance has most probably been swallowed either in food or medicine, from half an hour to an hour previously. It must be observed, however, that cases of poisoning may occur without the poison being introduced by the mouth. Oil of vitriol has been thrown up the rectum in the form of enema and caused death: the external application of arsenic, corrosive sublimate, and cantharides has destroyed life. In one case arsenic was introduced into the vagina of a female, and she died in five days under all the symptoms of arsenical poisoning.—(Schneider Ann. der. Ges. Staatsarzneikunde i. 229.) Such cases are rare, but nevertheless the certainty that they have occurred where their occurrence could hardly have been anticipated, shows that in a suspicious case, a practitioner should not deny the fact of poisoning, merely because it is proved that the patient could not have taken the poison in the usual way—by deglutition.

Let us suppose, however, the circumstances to have been such that these secret means of destruction could not have been resorted to, and that the poison is one of those most commonly selected by a murderer,

such as arsenic, oxalic acid, or corrosive sublimate, then we may expect that this character of poisoning will be made evident to us, and that something must have been swallowed by the patient shortly before these alarming symptoms appeared. By observations attentively made, it may be in our power to connect the appearance of the symptoms with a particular article of food, and thus indirectly lead to the detection of the criminal. Supposing that many hours have passed, since food or medicine was taken by the patient, without any effect ensuing,—it becomes very probable that the symptoms are due to some other cause, and not to poison. The time of the occurrence of the symptoms in relation to a particular meal, is then a fact of especial importance in forming an opinion when poisoning is suspected, as the following cases will show.

The *Crown Prince of Sweden* was considered by many to have been killed by poison. The prince, it appears, was reviewing some troops, when he was observed to fall suddenly from his horse, and he died half an hour afterwards. His physician, Dr. Rossi, was accused of having administered poison to him, and was obliged for his own security to quit the country. It is obvious, however, from an examination of the particulars of the case, that had this sudden attack been due to poison, it could only have been from one of the most active narcotics, given to him but a short time before he fell from his horse. But it was ascertained that the prince had taken neither solid nor liquid of any kind for at least *four hours* previously to his death. The allegation of poisoning was thus disproved, for no poison operating with symptoms like those under which the prince had died could have had its effects suspended for four hours. The cause of death was apoplexy.

In February, 1845, the following case was submitted to me by my friend Mr. J. G. French. A child between two and three years of age in tolerable health was one afternoon suddenly seized with stupor, convulsions, and insensibility, and died in twenty-three hours. After death the brain was found highly congested. All suspicion of narcotic poisoning was done away with by the fact that the child had taken nothing since its dinner at two o'clock, and the symptoms suddenly appeared at half-past five, *i. e.* three hours and a half afterwards. (Med. Gaz. xxxvi. 32.)

In either of these instances, had the symptoms speedily followed the meal, there would have been some obscurity. For another very instructive case, see Prov. Med. Journal, February 19, 1845, p. 114. By bearing in mind these facts, regarding the period at which the more common poisons begin to produce their effects, it may often be in our power to determine summarily whether the case be one of poisoning or not. In several instances which have been brought to Guy's Hospital, where narcotic poison was suspected to have been the cause of comatose symptoms and rapid death, there was no difficulty in deciding against the suspicion of poisoning, merely from observing the circumstances under which the attack took place. Facts of this kind may sometimes serve to establish the innocence of an accused party, and at others to point out the real criminal.

When symptoms resembling those of poisoning speedily follow the ingestion of food or medicine, there is always great room for suspicion;

but caution should be observed in drawing inferences, since the most extraordinary coincidences sometimes present themselves. In the celebrated case of *Sir Theodosius Boughton*, who was poisoned by his brother-in-law, Donellan, in 1781, the fact of alarming symptoms coming on in two minutes after the deceased had swallowed what was supposed to be a simple medicinal draught, became the most important evidence against the prisoner. There is no doubt that laurel water had been substituted for the medicine by the prisoner. I may here remark, that the practice of substituting poisonous mixtures for medicinal draughts or powders, is by no means unusual, although it might be supposed to indicate a degree of refinement and knowledge not commonly to be found among the lower class of criminals. Medical practitioners are thus apt to be imposed upon, and the following case, related by one of our present judges, will serve as a caution. An apothecary prepared a draught, into which another person put poison, intending thereby to destroy the life of the patient for whom the medicine was prescribed. The patient, not liking the taste of the draught, and thinking that there was something suspicious about it, sent it back to the apothecary, who, knowing the ingredients of which he had composed it, and wishing to prove to his patient that he had done nothing wrong, drank it himself and died. In this case, he was the unconscious agent of his own death; and although the draught was intended for another, the party who poisoned it, was held guilty of murder. This case contains a serious warning to medical witnesses. It is not very unusual on trials for poisoning, when the poison is conveyed through medicine, to find a medical witness offering to swallow his own draughts in a court of law, in order to furnish to the court and jury a convincing practical illustration of the innocence of the medicine! I need hardly observe that an exhibition of this kind is never required of a medical witness. The court will receive his deposition, without compelling him to swallow his own medicine, even supposing it not to have been secretly poisoned. If any doubt be raised of the innocent properties of the draught, a chemical analysis of its contents will be far more satisfactory, and attended with no kind of risk to the practitioner.

On the other hand, the occurrence of symptoms resembling those produced by poison, soon after food or medicine has been taken, may be a pure coincidence. In such a case, poison is always suspected by the vulgar; and it will be the duty of a medical jurist to guard against the encouragement of such a suspicion, until he has strong grounds to believe it to be well-founded. No public retractation or apology can ever make amends for the injury which may in this way be inflicted on the reputation of another; for those who hear the accusation, may never hear the defence. In all such cases, a practitioner may entertain a suspicion, but he should always avoid *expressing* it or giving it publicity. When death is not a consequence, it is difficult to clear up such cases, except by the aid of a chemical analysis; but this, as we

know, is not always applicable. If death ensue, the real cause is usually apparent, and a suspicion of poisoning is thus often removed by a post-mortem examination.

The fatal symptoms produced by perforation of the stomach, which so closely resemble those of arsenical poisoning, almost always attack an individual soon after a meal. When they occur some hours after, there is less likelihood of confounding them with arsenic. A few years ago, Mr. Hilton, of Guy's Hospital, and myself, had to examine a case of this description. The diagnosis was in a great measure aided by the fact, that the violent symptoms did not appear until about three hours after a meal. An instance occurred within my knowledge, where an aged lady took three grains of a white powder, prescribed for her by her medical attendant. In about ten minutes afterwards, she was seized with coma, and died in the course of an hour. The medicine which she took, was sulphate of quinine. In such a case it might have been most plausibly said,—morphia or some other poisonous alkaloid had been swallowed; but the circumstances were well known: death was due to apoplexy. In another instance, a woman, aged 37, rose in the morning in her usual health, with the exception of having a slight headache, and immediately after taking breakfast, was attacked with violent vomiting, which continued for half an hour, when she fell down and died suddenly. Here again there was room for suspecting poison, owing to the time of the occurrence of symptoms, but it was proved that the woman had died of disease of the brain. Many more such cases might be reported; but these will show that all inferences of poisoning under such circumstances, should be drawn with caution.

It seems highly probable that the mere fact of a person eating a full meal after *long fasting* will give rise to symptoms resembling those of irritant poisoning,—a circumstance which does not appear to have attracted the attention of writers on toxicology. Mr. Holland of Manchester, has communicated to me two cases of this description. In one the symptoms were very violent and the patient nearly died, in fact was laid out for dead. The other patient suffered from severe gastralgia for several weeks. Poisoning was at first strongly suspected, but the suspicion was removed by the fact, that others in health had partaken of the same food, principally potatoes mixed with gravy, without any injury, and there was no reason to suppose that any irritant poison could have been mixed with the food. The two who suffered were extremely weak and exhausted from long fasting, and were observed to eat their food, which was quite wholesome, voraciously.

3. In poisoning when several partake at the same time of the same food or medicine (mixed with poison) all suffer from similar symptoms.—This character of poisoning cannot always be procured; but it furnishes good evidence of the fact when it exists.

Thus, supposing after a meal made by several persons from the same dish, only one suffers, the suspicion of poisoning is considerably weakened. The poisoned article of food may be detected by observing whether those who suffer under symptoms of poisoning have partaken of one particular solid or liquid in common. In a case of accidental poisoning at a dinner-party, a friend of mine observed that those who suffered from the symptoms had taken port wine only: the bottle was examined, and found to be a saturated solution of arsenic in wine. In general, considerable reliance may be placed upon this character, because it is very improbable that any common cause of disease should suddenly attack with violent and alarming symptoms, many healthy persons at the same time, and within a short period after having partaken of food together. We must beware of supposing that where poison is really present, all will be attacked with precisely similar symptoms; because, as we have seen, there are many causes which may modify them. In general, that person who has partaken most freely of the poisoned dish will suffer most severely, but even this does not always follow. There is a well-known case recorded by Bonnet, where among several persons who partook of a dish poisoned with arsenic, those who had eaten little and did not vomit, speedily died; while those, on the other hand, who had partaken largely of the dish, and had in consequence vomited freely, recovered.

It was just now remarked, that there is no disease likely to attack several healthy persons at the same time, and in the same manner. This is undoubtedly true, *as a general principle*, but the following case will show that mistakes may occasionally arise even under these circumstances. It occurred in London during the prevalence of the malignant cholera in the year 1832. Four of the members of a family, living in a state of great domestic unhappiness, sat down to dinner in apparently good health; some time after the meal, the father, mother, and daughter, were suddenly seized with violent vomiting and purging. The stools were tinged with blood, while the blueness of the skin, observed in cases of malignant cholera, was wanting. Two of the parties died. The son, who was known to have borne ill-will against his father and mother, and who suffered no symptoms on this occasion, was accused of having poisoned them. A strict investigation took place before the coroner; but it was clearly shown by the medical attendant, that the deceased persons had really died of the malignant cholera, and there was no reason whatever to suspect that any poison had been administered to them. In this instance, it will be perceived that symptoms resembling those of irritant poison appeared suddenly in several individuals in perfect health, and shortly after a meal. We hereby learn that the utility of any rules for investigating cases of poisoning, depends entirely on the judgment and discretion with which they are applied to particular cases.

The case of the *Arzone* family, communicated by Dr. Wilson to the Medico-Chirurgical Society, May, 1842, is in this respect exceedingly interesting.

The man was an artist's colourman. He was seized with symptoms somewhat resembling irritant poisoning, and died in about three weeks. The mother and three of the children died subsequently, after having suffered from symptoms indicative of irritation in the alimentary canal. The facts appeared to show that some common cause was in operation, and poisoning was suspected, but no poison was found These cases were not satisfactorily cleared up, but the general opinion was, that the parties had died from obscure disease. I must also here call attention to the interesting case of *Solomon* v. *Lawson*, (Surrey Lent Assizes, 1845.) It was alleged that the defendant had libellously stated that the plaintiff, who was in the habit of supplying water to ships at Saint Helena, had supplied some water poisoned with lead or copper to a particular ship, and that this was the cause of an illness which prevailed among the passengers on the homeward voyage. It appeared in evidence that five of the officers and the steward were affected, and two of the officers suffered severely from symptoms, which although slightly varying in the respective cases, the surgeon of the ship did not hesitate to refer to some metallic poison. Two medical men who attended three of the passengers on their return to England, declared that in their opinion the effects were due to lead, which was rendered probable by the fact that partial paralysis of the lower extremities and blueness of the gums were among the symptoms. Some of the crew, however, did not suffer although they are stated to have used the same water. The water, as it was supposed but not proved, was analysed and no lead or copper was found in it. As so much depended on this analysis, it is to be regretted that its identity was not more clearly made out, and that it was not assigned to some of the most eminent chemists in London. It is impossible, I think, to draw any other conclusion from the evidence, than that drawn by the medical witnesses, *i. e.* that the cause of the symptoms was really owing to some metallic poison, probably to lead. The jury, however, held under the direction of the judge, (who strangely assigned the symptoms to overdoses of mercury!) that the water was not proved to have been poisoned and returned a verdict with very heavy damages against the defendant. To have attained strict justice in this case the facts, it appears to me, should have been referred to a medical board composed of experienced chemists and physicians. There is sufficient precedent for this, in the legally recognized assistance afforded to the Admiralty courts on nautical questions, by the masters of the Trinity House.

It is well to bear in mind, in conducting these inquiries, that symptoms resembling those produced by irritant poison may be sometimes due to the description of food which may have been taken at the meal. Besides flesh rendered unwholesome from disease and decay, there are certain kinds of shell-fish, as well as pork, bacon, sausages, cheese, and bread, which, under certain circumstances, may give rise to formidable symptoms, and even death. In such a case, all the foregoing characters of poisoning are brought out; and, indeed, the case may be regarded as one of poisoning by an animal or vegetable irritant. The diagnosis is difficult, and great ambiguity frequently arises, from the fact that not more than one or two individuals may be affected, who have frequently before partaken of the same kind of food without any particular inconvenience. (See pòst, Animal Irritants.)

4. The nature of the symptoms.—In cases of poisoning, the symptoms are commonly well marked, and have a peculiar character; while those of disease are less certain and more likely to create embarrassment. Owing to this, it happens that in practice, disease is much more liable to be mistaken for poisoning, than poisoning for disease. An account of the symptoms produced by the different

classes of poisons will be found (antè, p. 12.) It will now only be necessary, therefore, to enumerate on the one hand those diseases, the symptoms of which might be mistaken for irritant poisoning, and on the other those which might be mistaken for narcotic poisoning. The diseases, the symptoms of which resemble those produced by *irritant* poisons, are cholera, gastritis, enteritis, gastro-enteritis, peritonitis, perforation of the stomach or intestines, strangulated hernia, colic, and hæmatemesis.

Cholera.—It is necessary here to distinguish the common English cholera from the Asiatic or malignant form of the disease. In the Asiatic Cholera there is usually sudden and extreme prostration of strength; the surface of the body is very cold, and sometimes has a dark livid or leaden hue, especially observed in the skin of the hands and feet; the breath is cold as it issues from the mouth; the matters discharged from the bowels are very copious, they resemble rice-water with flakes of coagulated mucus floating in them. There is the most intense thirst, and the patient will drink large quantities of cold water. The symptoms of poisoning by arsenic and other irritants are wholly different from these, if we except perhaps the intense thirst which is present in both cases. The common English Cholera, as it occurs in summer and autumn, closely resembles arsenical poisoning in its symptoms. Thus, an attack often comes on in a healthy subject in about half an hour after a meal. It is accompanied by vomiting and purging, and by violent pain in the abdomen, continuing until death where the case terminates fatally.

Many acquittals on criminal charges have taken place from the great difficulty which exists in distinguishing this last-mentioned form of cholera from arsenical poisoning; and, in truth, it may be observed, that if in any case medical evidence rested upon symptoms alone, it would be scarcely possible, in some instances, to draw such a clear distinction between the symptoms of this disease and those of poisoning, as the law would deem absolutely necessary for conviction on a criminal charge. The rules recommended for forming a diagnosis, as they are laid down by the best writers on toxicology, do not appear to be very satisfactory. Perhaps the following may be taken as a statement of the most striking differences. In irritant poisoning the evacuations are often tinged with blood; in cholera they are not tinged with blood, but commonly deeply coloured by bile. In irritant poisoning, these evacuated liquids will sooner or later yield traces of poison when analysed. In cholera this is of course not the case. The attack of cholera is commonly dependent on some irregularity of diet, and appears chiefly in summer and autumn. Irritant poisoning may occur at any season. Persons do not often die from an attack of English cholera; and when the disease does prove fatal, it is commonly after three or four days from its commencement. In irritant (arsenical) poisoning, death is a common result within twenty-four hours, when the symptoms produced by the poison are such as to have resembled those of cholera, i. e. poisoning in its most acute form. In irritant poisoning, the symptoms usually

come on in about half an hour or an hour after a meal; and although cholera may commence its attack at about the same period, yet, supposing several persons to have partaken of the food, all will suffer more or less if it be really a case of poisoning,—not, if it be a case of cholera. It would be at least something very unusual, that several healthy persons should be attacked by cholera at the same time, unless the attack were owing to some improper kind of food used at the meal. (See case p. 28.) Lastly, an analysis of the food may serve to determine whether irritant poison was or was not the cause of the symptoms. Of all irritant poisons, arsenic comes the nearest to cholera in the character of the symptoms. It is right to bear in mind, however, that a case of arsenical poisoning is often accompanied by special symptoms, which are met with neither in cholera nor in any disease resembling it. Thus in persons who have taken arsenic and survived the first effects of the poison,—the conjunctivæ of the eyes often become inflamed, sometimes at a very early period,—there is also great irritation of the skin, followed by a peculiar herpetic eruption—and occasionally paralysis and coma appear among the symptoms. In cholera, nothing of the kind is witnessed; hence we have in these peculiarities, means for assisting us in our diagnosis. When the person dies, a post-mortem examination, with an analysis of the contents of the stomach, will often remove any doubts that may have existed on the real nature of the case.

Gastritis, Enteritis, Gastro-enteritis, Peritonitis.—These diseases do not commonly occur without some obvious cause; indeed, the two first must be regarded as the direct results of irritant poisoning. Thus arsenic and other irritants, when they prove fatal, commonly give rise to inflammation of the stomach and bowels. In all cases where these diseases present themselves, the object of the practitioner is therefore to determine the *cause* of the inflammation, whether it be due to natural causes or the action of an irritant poison. The diagnosis will chiefly rest, 1. Upon the time of the occurrence of the symptoms after a meal. 2. The order of their occurrence. 3. The obstinate constipation of the bowels, which is observed in gastritis and enteritis, as contrasted with the violent vomiting and purging met with in irritant poisoning. 4. The presence of fever in these diseases. 5. The history of the case so clearly explains its nature, that we seldom hear of these diseases being mistaken for irritant poisoning. The same observations apply to peritonitis, in which disease there is also constipation, and but little vomiting. It has been doubted by some pathologists whether the diseases above mentioned can occur spontaneously, and without any apparent cause. All agree that cases of idiopathic acute gastritis, are rarely observed in individuals otherwise healthy. One case of this kind however has been lately reported by Mr. Berncastle, (Lancet, March 1844.) The symptoms were of the usual character—constant vomiting, no diarrhea and rapid sinking. After death the stomach was found in a high state of inflammation, but all the other viscera were healthy. A suspicion of poisoning did not attach to the case.

PERFORATION OF THE STOMACH AND INTESTINES.—The symptoms attending perforation of the stomach, in some respects resemble those of irritant poisoning. They often occur suddenly to a healthy person after a meal;—but as this disease is invariably fatal, and is immediately recognised on a post-mortem examination, it is unnecessary to make any observations on the means of diagnosis.

STRANGULATED HERNIA.—It is difficult to suppose that this disease should ever be confounded with irritant poisoning. The seat of pain, with an examination of the part, would at once show the physical cause to which the symptoms were due.

COLIC.—This disease can only be confounded with one variety of irritant poisoning, namely, that induced by the salts of lead. But it is to be observed, that the poisonous salts of lead are very rarely used criminally, and when they are taken in sufficiently large doses to kill rapidly, the symptoms resembling colic are mixed up with those of irritant poisoning; so as to render it impossible for a practitioner to refer them to that disease alone.

HÆMATEMESIS.—In this disease, there is neither pain nor diarrhea; and there is a copious discharge of blood by vomiting. These characters show that it cannot be easily mistaken for irritant poisoning.

We may now proceed to speak of the diseases which have symptoms resembling those induced by *narcotic* poisons. They are apoplexy, epilepsy, diseases of the brain, diseases of the heart, rupture, or distension of the stomach. Indeed, it may be remarked, that every condition of the body in which life is liable to be suddenly destroyed, from whatever cause, may be mistaken for narcotic poisoning. The various causes of sudden death should therefore be especially studied by a medical jurist. These are not very numerous, and are principally confined to diseases affecting the brain, heart and lungs. For an account of these causes, I must refer the reader to the Ann. D'Hyg. 1838. ii. 145; 1843. ii. 435; also to my MANUAL OF TOXICOLOGY. There is another point to be attended to, namely, that those fatal diseases only of these important organs, are likely to be confounded with this form of poisoning, the existence of which had not been previously suspected or announced by the usual attendant symptoms. On the late trial of *Tawell* for poisoning Sarah Hart by prussic acid, the statistics of the causes of sudden death were entered into in the defence, in order to establish a probability that the deceased had died from natural causes, among which was placed "mental emotion!" It may be as well therefore to state, that on an average of five years, 1838–42, the annual number of sudden deaths in England and Wales amounted to 3600, or one in one hundred and thirty-eight of the total deaths. Registrar General's Report, 1843.

APOPLEXY.—Narcotic poisons, of which we may take opium as the type, actually seem to produce this diseased condition of the brain. The distinction of apoplexy dependent on disease, from that kind of apoplexy induced by poison, is extremely difficult unless we can obtain a full history of the case. The following circumstances may be remem-

bered in our diagnosis. 1. Apoplexy, as a disease, is sometimes preceded by warning symptoms before the fatal attack comes on. In poisoning, such symptoms would be wanting unless the poison were administered to a person who had already been threatened with apoplexy. 2. Apoplexy, as a disease, does not commonly attack persons under the age of thirty and perhaps most frequently occurs between thirty and fifty years of age. (See Copeman on Apoplexy. 1845. p. 3.) We shall presently see that there are exceptions to this character. Poisoning may be witnessed in a person at any age. 3. The relation between the time of the attack, and the time at which food or medicine was last taken. Thus if the comatose symptoms do not come on until five or six hours after some liquid or solid has been swallowed, they are much more likely to depend on apoplexy from disease, than on poison. This is a most important character; but its occurrence is of course purely accidental, for it is by no means unusual that an attack of apoplexy should speedily follow a meal made by a previously healthy person. However, cases have already been related, which show that this may be sometimes usefully employed to distinguish disease from poisoning, (antè, p. 25.) 4. In apoplexy from disease, it is usually observed that coma is at once induced:—but in poisoning, coma comes on slowly, and is generally preceded by vertigo and stupor. 5. The discovery of poison in the food taken or in the contents of the stomach:—this would at once establish the fact of poisoning. 6. The discovery of appearances in the brain indicative of apoplexy, such as effusion of blood. This would negative, cæteris paribus, the presumption of poisoning.

It is to be observed, that in all cases of disease simulating narcotic poisoning, the disease is assumed to prove fatal:—hence there is always the opportunity of searching for the two last-mentioned characters. We do not hear of apoplexy from which a person recovers, ever being mistaken for a case of poisoning by opium, but we hear of poisoning by opium being not unfrequently mistaken for apoplexy or convulsions. Dr. Birt Davies has lately published the two following cases. A person died in what was considered by the physician and surgeon attending to be a fit. Opium was found in the stomach. A person was attended by a physician and surgeon for some hours. The illness and death were ascribed to and treated by them for apoplexy, but it was proved beyond all doubt that the deceased died from laudanum. (Borough Inquests. Birmingham, 1845.) Such cases I am persuaded are frequent, having had several referred to me since the publication of the first edition of this work. In two of these the deaths were registered as from "natural causes," when on exhumation of the bodies some weeks after, the deceased were found to have died from poison. It is impossible to say how many escape notice for one which is detected. These facts show that inquests without post-mortem examinations in many cases serve, by lulling suspicion, to conceal rather than to detect crime.

A case was lately tried at the Lincoln assizes, which shows that a crafty

criminal may easily deceive a medical practitioner, and that the coroner's inquest, as it is at present conducted, is not fitted to detect these secret cases of poisoning. In this instance, a confession was made; but how many instances escape detection for want of a confession on the part of a criminal, it is impossible to conjecture. An inspection of a body is not required by many coroners unless there are strong circumstances for suspicion in the shape of public rumour; but in respect to criminals, who have well calculated their plans, these circumstances are not likely to come to light except from a post-mortem inspection, and an analysis of the contents of the viscera. It does not appear that an inquisition was held or inspection made in the case alluded to, until some time after the bodies of the deceased had been interred, and then it was too late. A woman was charged with the murder of three children by poisoning one of them with arsenic, and the other two with opium. She pleaded guilty, and confessed the manner in which the crime was perpetrated. She had succeeded in poisoning two of the children without being detected, although suspicion was so strong that she was tried, but acquitted, at the previous assizes, on the charge of having poisoned one of them. In the third case, she admitted having secretly given the deceased, (her own infant,) about three weeks old, a teaspoonful of laudanum. The child was soon afterwards seized with convulsions; a medical practitioner was sent for, who, deceived by the statement of the woman, treated it as a case of ordinary convulsions in children, and ordered a warm bath. The child died in about twenty hours, continuing, according to the prisoner's statement, in convulsions during the greater part of that time. No suspicion appears to have been entertained of the real cause of death, and the case would probably have remained undiscovered, but for the prisoner's confession. It is remarkable that this child survived so long; the woman, however, prevaricated as to the quantity of laudanum which she gave it, therefore it is difficult to draw any conclusion from her statement, except that the deceased was actually poisoned by opium. (The *Queen v. Joyce*. Lincoln Aut. Ass. 1844.) In one case referred to me (Sept. 1844,) the jury, under the direction of a coroner, returned a verdict of death from poison ("misadventure,") while the stomach of the deceased was in my custody, and before it had even been opened, or the seals of the vessels containing it, had been broken! In another, in which there was the very strongest reason to suspect death from poison administered by a quack, the coroner and jury declined waiting for an analysis of the contents of the stomach, although strongly advised by the medical witness who inspected the body,—and returned a verdict of "*natural death*." (See also the case of *Reg. v. Freeman*, Taunton Lent Assizes, 1845.)

In reference to the age at which apoplexy may make its attack, it may be remarked that healthy girls of the respective ages of sixteen and twenty-two, have died suddenly from this disease. There had been no warning symptoms whatever. I have known a child between two and three years of age, die from congestive apoplexy, but the disease has been observed to occur even in infants. Dr. A. Campbell reports a case of apoplexy proving fatal in a child only eleven days old. (North. Jour. Med., Jan. 1845.) A remarkable case, involving the question—whether death was caused by prussic acid or apoplexy, has just been decided by the Senate of Chambery (April, 1843). I allude to that of *M. Pralet*, (Ann. D'Hyg. xxvi. 399, xxix. 103, 474,) which appears to have excited as much attention on the continent, as the case of Sir T. Boughton, in England. Several medical witnesses deposed that the deceased had died from prussic acid, administered to him by M. L'Heritier,

the accused. Orfila was required to examine the medical evidence, and found it extremely defective. The inferences drawn from the application of the chemical tests were highly improper; and the results were essentially negative. Had it not been for the interference of Orfila, it is most probable that the accused would have been convicted, more from the strong medical opinions against him, than from the medical facts of the case. The witnesses appear to have acted on the principle, that the whole of their duty consisted in rendering the charge of poisoning probable; whereas, we shall hereafter see that no person can be convicted of this crime on mere *probability*: the fact of poisoning must be made reasonably certain, either by medical or moral evidence, or by both combined. The case of *Tawell* presents a converse illustration. Here where the cause of death was obviously prussic acid a struggle, was made to show, on the most untenable hyper-chemical and hyper-pathological grounds, that the deceased had died from apoplexy or some other sudden cause. (Bucks Lent Assizes, 1845.)

Epilepsy.—This disease, in some of its symptoms, resembles poisoning by prussic acid only. If the symptoms depend on poison, some liquid or substance must have been taken immediately before their occurrence. If, however, nothing has been taken, the inference is that the symptoms most probably depended on disease. Death is commonly very rapid in poisoning by prussic acid; but a first attack of epilepsy is not often fatal. If the person has suffered from previous attacks, the probability is, cæteris paribus, that the symptoms depend on disease. But epilepsy may by coincidence immediately follow the administration of a draught or the taking of food:—an analysis of the substance taken would in such a case remove any doubt. Supposing none of this to be procurable, then we must remember, that epilepsy only simulates narcotic poisoning when the attack is rapidly fatal. Therefore, an opportunity will always present itself for verifying or rebutting the suspicion of poisoning, by examining the contents of the stomach. I have never met with an instance, where a case of epilepsy was mistaken for one of narcotic poisoning.

Diseases of the brain and spinal marrow.—Among these diseases, may be mentioned inflammation of the brain and its membranes, hypertrophy, and the formation of tumours. Such diseases are of a very insidious nature:—they sometimes give no warning of their presence until the person, who may be in his usual health, is suddenly seized with stupor, followed by coma, and he rapidly dies. All such cases resemble poisoning by opium; they can only be distinguished by the discovery of the affirmative characters of disease, on a post-mortem examination, and an absence of poison from the stomach. Besides, the period of access of the symptoms after a meal, and the rapidity of death, will, in many instance, allow a practitioner to form a satisfactory diagnosis. I have already referred to a case, (antè, p. 27,) where a woman, aged thirty-seven, died suddenly, soon after having taken her breakfast.

On an examination of the body, there was found effused within the cranium, a large quantity of bloody serum; and the brain and its membranes were much congested with blood. No poison was discovered in the stomach, and it is certain, that had death been due to a narcotic, some traces of it would have been fonud, in consequence of the great rapidity with which the deceased died. The only points in which this resembled a case of poisoning, were in the invasion of the symptoms soon after a meal, and their rapidly fatal termination.

DISEASES OF THE HEART.—The heart is subject to many diseases, which present the same insidious characters, as those of the brain. Thus they may remain for a long time latent, and then suddenly destroy life. They are only likely to be confounded with poisoning by prussic acid, owing to the rapidity with which death takes place. In all these cases, therefore, if the fatal attack suddenly occur some time after food or medicine has been taken, there can be no reason for attributing it to poison. It is only where by a coincidence the symptoms come on at or immediately after something has been swallowed by the patient, that any doubt of the cause to which they may be due, can arise; and here, the doubt would be speedily removed by a post-mortem examination of the body. We must not expect, however, that in these fatal affections of the heart, well-marked post-mortem appearances will be always met with. Some pathologists have described a singular condition of this organ, under which the person dies suddenly after experiencing nausea, vertigo, and fainting. In such cases, the parietes of the heart have been found only preternaturally flaccid, and its cavities empty. This has been called by Mr. Chevalier, idiopathic asphyxia, and others have termed it syncopal asphyxia. It does not appear to be very common, for very little is known concerning it, or on what the cause of death really depends. In regard to its diagnosis in suspected cases, all that we can say is, that if poisoning be not clearly negatived by concurrent circumstances, the usual affirmative characters are entirely wanting.

DISTENSION OF THE STOMACH.—This is by no means an unfrequent cause of sudden death, it may occur at any age. In some instances, the distension of this organ appears to act by inducing apoplexy, the usual marks of that disease being found in the brain. In other cases, death appears to be due to a fatal impression analogous to shock, arising simply from the excessive mechanical distension of the organ: it is not surprising, that a suspicion of poisoning should occasionally arise under such circumstances. I have known several instances which have occurred within the last few years in this metropolis, where the individuals went to bed in their usual health after eating a hearty supper, and were found dead the following morning. On dissection, no marked changes were discovered, excepting in some, slight congestion of the cerebral vessels. The most striking appearance was the enormously distended state of the stomach itself.

RUPTURE OF THE STOMACH is said sometimes to occur as a conse-

quence of over-distension, combined with efforts at vomiting. Death is, of course, a speedy consequence of this accident. Hence no difficulty can arise in practice with regard to it, because a post-mortem examination would enable the practitioner at once to determine the cause of death.

When called to examine a case of suspected narcotic poisoning, where the symptoms have occurred soon after a meal, the practitioner must remember that although a full meal is a very common exciting cause of apoplexy, this is not the case with any simple medicine, liquid or solid, which may have been swallowed by the patient. Should the symptoms follow the taking of a draught or any kind of medicine, the circumstances become more suspicious, for the occurrence of apoplexy in such a case, would be a pure coincidence :—all we can say is, that it may happen—in proof of which we may refer to the case mentioned antè, p. 27, and then we require other circumstances to aid our judgment. In the case of *Sir Theodosius Boughton*, the narcotic symptoms supervened in two minutes after he had taken, what was supposed to be a simple purgative draught; and it was this fact, no doubt, that strongly influenced the jury in their verdict. The draught, it was presumed, had contained laurel water; and with some strong facts in favour of this presumption, they were unwilling to assume that the symptoms under which the deceased laboured after taking it, were owing to a coincidental attack of apoplexy or epilepsy. In all such cases, it can never be assumed that the medicine taken was the cause of the symptoms, unless we suppose it to have been a poison; while when the symptoms follow an ordinary meal, apoplexy may be a natural result,—at least it is not absolutely necessary, in order to account for them, to suppose that the food contained any poison.

5. The discovery of poison in the food taken, or in the matters vomited. One of the best proofs of poisoning in the living subject, is the detection of poison by chemical analysis either in the food taken by the person labouring under its effects, or in the matters vomited. The evidence is, of course, more satisfactory where the poison is discovered in the matters vomited, than in the food; because this will show that poison has really been taken, and will readily account for the symptoms. If thrown away, we must then examine the food of which the patient may have partaken. Should the results in both cases be negative, the probability is, that the symptoms may have been due to disease. In investigating a case of poisoning in the living subject, a medical jurist must remember, that poisoning is sometimes *feigned*, and at others, *imputed*. It is very easy for an artful person to put poison into food, and to accuse another of having administered it, as well as to introduce poison into the matters vomited or discharged from the bowels. There are few of these accusers who go so far as to swallow poison under such circumstances, there being a great dread of poisonous substances among the lower orders; and it will be at once

apparent, that it would require a person well versed in Toxicology, to feign a series of symptoms which would impose upon a practitioner at all acquainted with the subject. In short, the difficulty reduces itself to this :—what inference can we draw from the chemical detection of poison in food? All that a medical man can do, is to say whether poison be present or not in a particular article of food :—he must leave it to the authorities of the law, to develope the alleged attempt at administration ;—but if the poison have been actually administered, then we should have the usual symptoms. With regard to the detection of poison in the matters vomited from the stomach, this affords no decisive proof that it has been swallowed except under two circumstances :—1. When the accuser actually labours under the usual symptoms of poisoning, in which case there can be no feigning, and the question of imputation is a matter to be established by general evidence. 2. When the matters are actually vomited into a *clean vessel* in the presence of the medical attendant himself, or of some person on whose testimony perfect reliance may be placed. For an atrocious case of imputed poisoning in which the accused party had a narrow escape of his life, see Ann. D'Hyg., 1836, ii. 391.

CHAPTER V.

ON THE EVIDENCE OF POISONING IN THE DEAD SUBJECT.

Supposing that the person is dead, and we are required to determine whether the case be one of poisoning or not, we must, in the first instance, endeavour to ascertain all the particulars which have been discussed in the last chapter, as indicative of poisoning in the living subject. Should the deceased have died from poison, the circumstances of the attack, and the symptoms preceding death, ought to correspond with the characters already described. The additional evidence to be derived from the death of the person may be considered under the following heads.

1. The time at which death takes place after the first occurrence of symptoms.—This question it is necessary to examine, because the more common poisons, when taken in fatal doses, produce their fatal effects within certain periods of time. By an attention to this point, we may, in some instances, be enabled to negative a charge of poisoning, and in others to form an opinion of the kind of poison which has been taken. In a Court of law, a medical practitioner is often required to state the usual *period of time* within which poisons prove fatal. It is to be observed, that not only do poisons differ from each other in this respect, but the same substance, according to the form or quantity

in which it has been taken, will differ in the rapidity of its action. A large dose of strong prussic acid, i. e. from half an ounce to an ounce, will destroy life with great rapidity. In ordinary cases of poisoning by this substance, a person dies, i. e. all signs of life have commonly ceased in from ten to twenty minutes :—if he survive half an hour, there is some hope of recovery. In the cases of the seven Parisian epileptics, accidentally poisoned by this acid, the first died in about twenty minutes, the seventh survived three quarters of an hour.—(See post, PRUSSIC ACID.)—Oxalic acid, one of the most energetic of the common poisons, when taken in a dose of from half an ounce to an ounce, may destroy life in from ten minutes to an hour: if the poison be not perfectly dissolved when swallowed, it is a longer time in proving fatal. The strong mineral acids, in poisonous doses, destroy life in about eighteen or twenty-four hours. Arsenic, under the form of arsenious acid (white arsenic), operates fatally in from eighteen hours to three or four days. It has, however, in more than one instance, killed a person in two hours; although this is by no means common. Opium, either as a solid or under the form of laudanum, commonly proves fatal in from six to twelve hours; but it has been known to destroy life in less than three hours :—those who survive the effects of this poison for twelve hours, are said to have a fair chance of recovery. This must be understood to be merely a statement of the average results, as nearly perhaps as we are warranted in giving an opinion : but the medical jurist will of course be aware, that the fatal period may be protracted or shortened, according to all those circumstances which have been stated to affect the action of poisons.

There are various forms which this question may assume in a Court of law :—the death of a party, alleged to have taken poison, may have occurred too rapidly or too slowly to justify the suspicion of poisoning. The following case may serve as an illustration. A woman of the name of *Russell* was tried and convicted at the Lewes Summer Assizes in 1826, for the murder of her husband, by poisoning him with arsenic. The poison was detected in the stomach; but the fact of poisoning was disputed by some medical witnesses, for this among other reasons—that the deceased had died *three* hours after the only meal at which the poison could have been administered to him. The authority of Sir A. Cooper and others, was cited to show, that, according to their experience, they had never known a case to prove fatal in less than seven hours. This may well have been; but, at the same time, there was sufficient authority on the other side, to establish that some cases of arsenical poisoning had actually proved fatal in three or four hours. So far as this objection was concerned, the prisoner was very properly convicted.

On the medical question raised at this trial, I may observe, that within the last few years two distinct cases have occurred where the individuals died certainly within two hours after taking this poison; and several instances have been reported since the trial, in which death

took place in from three to four hours after the administration of arsenic. It seems extraordinary in the present day, that any attempt should have been made by a professional man to negative a charge of criminal poisoning upon so weak a ground as this; but we must remember, that this opinion was expressed seventeen years ago, when the subject of toxicology was but little understood. It is quite obvious, that there is nothing, so far as we know, to prevent arsenic from destroying life in one hour. A case will be hereafter related, in which death took place, most probably from arsenic, in half an hour. These matters can only be settled by a careful observation of numerous cases, and not by any à priori reasoning or reference to personal experience.

In all instances of sudden death, there is generally a strong tendency on the part of the vulgar to suspect poisoning. They never can be brought to consider, that persons may die a natural death suddenly, as well as slowly; or, as we shall presently see, that death may really take place slowly, as in cases of disease, and yet be due to poison. This prejudice continually gives rise to the most unjust suspicions of poisoning; a case illustrating this has already been given antè, (p. 25.) One of the means recommended for distinguishing narcotic poisoning from apoplexy or disease of the heart, is the difference in the rapidity with which death takes place. Thus, apoplexy or disease of the heart may prove fatal either instantly or within an hour. The only common poison likely to operate with such fatal rapidity is prussic acid. But when this is the cause of death, some traces of the poison will be found at hand, except in a case of murder, (*Reg.* v. *Tawell,* Bucks, Lent Ass. 1845.) Poisoning by opium is commonly protracted for five or six hours. This poison has never been known to destroy life instantaneously, or in a few minutes. I here exclude strychnia, as well as morphia and its salts; for these are poisons out of common reach. Thus, then, it may happen, that death will occur with such rapidity, as to render it impossible to attribute it to narcotic poison under the circumstances.

Sometimes the only medical evidence on which we may have to speak to the fact of poisoning will be the *duration* of the case. There is then, of course, great difficulty in forming an opinion; but we may generally be able to say whether the time which the party survived after his first illness was or was not compatible with any known form of poisoning; and also in some instances to determine the probable nature of the poison, if any were really taken by the deceased. The following case is in some respects interesting. It occurred a few years since in the metropolis, to a gentleman who was then one of my pupils, and consulted me respecting it.

A woman, by occupation a laundress, was found lying dead on the floor of her kitchen. The deceased was about forty years of age, of spare make and of temperate habits. When first seen, she was lying on the stone floor in a curved position, on her right side, her right cheek being in a plate which contained four ounces of light brown liquid, mixed with mucus. There was no

doubt that this had issued from her mouth by vomiting. The countenance did not express anxiety or pain, but the lips were somewhat drawn in. There was no suffusion about the eyes. The surface was slightly livid. She was but lightly clothed. Some bread and meat were found at a distance, and on a shelf, in a distant part of the kitchen, were some bottles of oil, which had evidently not been touched. No bottle containing poison, nor any weapon was found about the place. There were no marks of violence on the person. The woman had been a little indisposed for about a fortnight previously, and had taken medicine. She, however, was well enough to work. She was last seen alive about five or six o'clock in the afternoon, when she appeared in her usual health, and was heard moving about in her room at half-past nine the same evening:—she was found dead twelve hours afterwards, i. e. at half-past nine the following morning. As the body was quite cold, and the members perfectly rigid when first seen, it is reasonable to presume, that the deceased had been dead at least ten hours—the weather not being very cold at the time. Hence it was probable that she had died about half-past eleven o'clock at night, i. e about *two hours* after she had been heard moving in her room, and about five or six hours after she was last seen in her usual health and spirits. From these facts, it was considered very unlikely that she should have died from poison. The only poisons which could be suspected, to prove so rapidly fatal, were prussic acid, opium, or oxalic acid. Had prussic acid been the cause, it would have been easily discovered by the odour, as well as by some of the poison being found near. Had opium or oxalic acid been the cause of death, a portion of either of these bodies would have been found in the liquid vomited in the plate, but this contained no trace of any kind of poison. The deceased could not have died very suddenly, since she had had time to take a plate from the sideboard and lie down with it. Had she fallen with the plate in her hand, it must have been broken on the stone floor. Besides, as there were no marks of vomiting on the front of her dress or elsewhere in the room, it is pretty certain that she must have vomited while in the recumbent position. At the inquest, no post-mortem examination was required by the coroner or jury; and therefore it is difficult to say what was really the cause of death. The gentleman who conducted the case, very properly inferred that the deceased had not died from poison.

When a poison destroys life rapidly, it is called a case of *acute* poisoning, to distinguish it from the *chronic* form, i. e. where death takes place slowly. Chronic poisoning is not a subject which often requires medico-legal investigation. Most poisons are capable, when their effects are not rapidly manifested, either from the smallness of the dose or from timely treatment, of slowly undermining the powers of life, and killing the patient by producing emaciation and exhaustion. This is sometimes observed in the action of arsenic and corrosive sublimate, but it has been remarked also in cases of poisoning by the mineral acids and caustic alkalies. Death is here an indirect consequence:—stricture of the œsophagus is induced, or the lining membrane of the stomach is destroyed and the process of digestion impaired:—a condition which leads to emaciation and death. The time at which these indirect effects will prove fatal, is of course liable to vary. A person has been known to die from a stricture of the œsophagus brought on by sulphuric acid, *eleven months* after the poison was swallowed; and there is no reason to doubt that instances may occur of a still more protracted nature. In these cases of *chronic poisoning* there is considerable difficulty in

assigning death exclusively to the original action of the poison, since the habits of life of the party,—a tendency to disease, and other circumstances, may have accelerated a fatal result. To connect a stricture of the œsophagus with the act of poisoning by a mineral acid, it is necessary to show, that there was no tendency to this disease before the acid was administered:—that the symptoms appeared soon after the first effects of the poison went off:—that these symptoms continued to become aggravated until the time of death; and that there was no other cause to which death could with any probability be referred. These remarks apply equally to the indirect fatal effects of any poison, such, for instance, as the salivation occasionally induced by corrosive sublimate where the acute form of poisoning by that substance has passed away. It has been stated, that chronic poisoning is not a subject commonly requiring a criminal investigation. Two cases have, however, came before our tribunals, in which the facts connected with this form of poisoning were of some importance. I allude to those of *Blandy*, tried at Oxford, in 1752, for the murder of her father by arsenic, and of a woman named *Butterfield*, tried at Croydon, in 1775, for the murder of a Mr. Scawen, by administering corrosive sublimate. In most cases, murderers destroy life by administering poison in very large doses; but in these instances, small doses were given at intervals, a fact which led to great medical doubt of the real cause of the symptoms before death. It is, however, very rare to hear of this form of poisoning.

It has been already remarked, that some poisons have what is called an *accumulative* property, i. e. they may be administered for some time in small doses without producing any marked effects, but they will, perhaps, after a certain period, suddenly and unexpectedly give rise to violent symptoms, affecting the life of a person. This peculiar mode of action has been witnessed more in medical practice than in cases of attempts to poison; hence it is not a subject of much importance to a medical jurist. Foxglove (digitalis) is said to possess this property, and it has been remarked that, on more than one occasion, persons to whom this medicine has been repeatedly administered in small doses have suddenly died, probably from the accumulative properties of the poison. The same effect has been noticed in the case of other poisons.

2. Evidence from post-mortem appearances.—One of the chief means of determining whether a person has died from poison is an examination of the body after death. In relation to external appearances, there are none indicative of poisoning upon which we can safely rely. It was formerly supposed, that the bodies of persons who were poisoned, putrefied more readily than those of others who had died from natural disease; and evidence for or against poisoning, was at one time drawn from the external appearance of the body. This is now known to be an error; the bodies of persons poisoned are not more rapidly decomposed, cæteris paribus, than those of others who

have died a sudden and violent death from any other cause whatever.

Irritant poisons act chiefly upon the stomach and intestines, which they irritate, inflame and corrode. We may likewise meet with all the consequences of inflammation, such as ulceration, perforation and gangrene. Sometimes the coats of the viscera are thickened, at other times thinned, by the action of an irritant.

Narcotic poisons do not commonly leave any well-marked post-mortem appearances. The stomach and intestines present no unnatural changes. There is greater or less fulness of the cerebral vessels; but even this is often so slight as to escape notice, unless attention be particularly directed to the brain. Extravasation of blood is rarely found.

The Narcotico-Irritants affect either the brain or the alimentary canal, and commonly both, according to their peculiar mode of action.

In concluding this brief notice, it must be observed that both irritants and narcotics may destroy life without leaving any appreciable changes in the body. To such cases as these, the remarks about to be made do not apply. The evidence of poisoning must then be derived from other sources. Any evidence derivable from the appearances in the body of a person poisoned would be of no value unless we were able to distinguish them from those analogous changes, often met with as a result of ordinary disease. These are confined to the mucous membrane of the stomach and bowels. They are redness, ulceration, softening, and perforation. All of these conditions may depend upon disease as well as upon the action of irritant poisons.

Redness.—It is a main character of the irritants to produce redness of the mucous membrane of the stomach and small intestines. This redness, when first seen, is usually of a deep crimson colour, becoming brighter by exposure to air. It is sometimes diffused over the whole mucous membrane:—at other times in patches over the surface of the stomach. It is sometimes met with at the smaller, but more commonly at the larger extremity of the organ; and then, again, we occasionally find that the rugæ or prominences of the mucous membrane only, present this red or inflamed appearance.

Redness of the mucous membrane may, however, be due to gastritis or gastro-enteritis, and in order to assign the true cause, it will be sometimes necessary to have an account of the symptoms preceding death, or some proof of the existence of irritant poison in the contents of the stomach or the tissues of the body. In this respect the following case (*Reg.* v. *Hunter*, Liverpool Spring Assizes, 1843,) is of some interest. A woman was charged with having poisoned her husband by arsenic. The medical evidence rested chiefly on the symptoms and post-mortem appearances, for no arsenic was discovered in the body. The mucous membrane of the stomach and intestines was found, throughout its whole extent, exceedingly inflamed and softened. The

medical witnesses for the prosecution referred this condition to the action of arsenic; those for the defence considered that it might be owing to idiopathic gastro-enteritis, independently of the exhibition of any irritant. The circumstances of the case were very suspicious; but the prisoner was acquitted, not merely on account of the variance in the medical evidence, but from the absence of positive proof of poison, i. e. its detection by chemical analysis. This generally weighs much with a Court or law, although it is well known that arsenic cannot always be detected in the body of a person who has undoubtedly died from a large dose of that substance. It is right to state, as a warning to medical witnesses, that the judge who tried the case expressed regret that, on the non-discovery of poison in the contents of the stomach and intestines,—the soft parts of the body (the muscles) had not been examined according to the processes suggested by Orfila.—(See the published reports of the case by Mr. Holland and Mr. Dyson.)

In the healthy state, the mucous membrane of the stomach is pale and white, or nearly so, except during digestion, when it becomes reddened, and some observers have remarked, that a slight redness has often remained in the stomachs of those who have died during the performance of the digestive process. Where in contact with the spleen or liver, the stomach is apt to acquire a deep livid colour from transudation, and it is well known that the bowels acquire a somewhat similar colour from the gravitation of blood, which always takes place after death. None of these appearances are likely to be mistaken for the action of an irritant poison.

There is an important class of cases in which redness of the mucous membrane of the stomach is found after death, not dependent on the action of poison or on any assignable cause. These cases, owing to their being so little known and involved in much obscurity, deserve great attention from the medical jurist; since the appearances closely resemble those produced by irritant poison. A person may die without suffering from any symptoms of disordered stomach: but on inspection of the body, a general redness of the mucous membrane of that organ will be found, not distinguishable from the redness which is so commonly seen in arsenical poisoning. Several cases of this kind have occurred at Guy's Hospital; and drawings have been made of the appearance of the stomach, and are now preserved in the Museum collection. A record has been kept of four of these; and it is remarkable that, although in not one of them, before death, were there any symptoms observed indicative of irritation or disease of the stomach, yet in all, the stomach was found more or less reddened, and in two extensively so. Such cases are not very common; but the certainty of their having occurred where poisoning could not be suspected, should place the witness on his guard, so that he be not led to countenance a suspicion of poisoning too hastily. In order to distinguish them, we must note whether there have been symptoms during life, and their nature. As, in the above cases there may have been no symptoms, or they may

have only amounted to slight gastric disturbance. Under these circumstances, they could not be mistaken for irritant poisoning. Such cases are only likely to lead into error, those who trust to this post-mortem appearance alone as evidence of poisoning;—but no medical jurist, aware of his duty, could ever be so misled.

This redness of the stomach, may truly occur where there is some ground for suspicion, as in the following case, communicated to the Medical Gazette by Mr. Tyson, of Beccles. A young woman, far advanced in pregnancy, died suddenly in a fit of syncope, soon after rising one morning. She had been in ill-health previously; but nothing existed to indicate that she had taken poison. Indeed, from what has been already said, the suddenness of her death was rather against the suspicion that she had died from such a cause. Yet after death, it was found among other appearances that the mucous membrane of the stomach was inflamed (reddened?) and thrown into rugæ. Although the case was very badly investigated by the coroner, who refused to allow a post-mortem examination, (which was made after the inquest only by consent of the friends,) it appears to me, that this was an instance similar to those above described, the redness being due to some unknown cause, but not to poison. An interesting case, in which it is probable that this pseudo-morbid appearance of the mucous membrane was mistaken for the effects of irritant poison, will be found in the Ann. D'Hyg., 1835, i. 227. Dr. Yelloly long since remarked, that the mucous membrane of the stomach often presented a high degree of vascularity (redness) in cases of sudden death. He met with this appearance in the stomachs of some executed criminals, whose bodies were examined soon after they had undergone the sentence of the law. In a paper read before the Med. Chir. Society in November 1835, this gentleman has re-examined the whole subject, and has given the results of numerous observations. They are of great interest to the medical jurist. Dr. Yelloly has endeavoured to show:—1. That vascular fulness of the lining membrane of the stomach, whether florid or dark coloured, is not a special mark of disease, because it is not inconsistent with a previous state of perfect health. 2. That those pathologists were deceived, who supposed, from the existence of this redness in the stomach, that gastritis sometimes existed without symptoms. 3. That erroneous conclusions as to the cause of death were frequently owing to the same mistaken observations:—the effects of putrefaction and spontaneous changes induced by the loss of vitality, being sometimes attributed to the action of poisons. 4. That the vascularity in question, is entirely venous, the florid state of the vessels arising from the arterial character of the blood remaining in the veins for some time after its transmission from the arterial capillaries at the close of life:—the appearance is however sometimes due to transudation only. 5. That the fact of inflammation having existed previously to death, cannot be inferred merely from the aspect of the vessels in a dead part:—there must at least have been symptoms during life. (See Medical Gazette, vol. xvii. p. 309.)

Andral and other pathologists have adopted similar views, and these views have obviously a most important bearing upon medico-legal practice : since there is generally a tendency to suspect poisoning wherever redness of the mucous membrane of the stomach is met with in the dead. Such a condition does not even prove the past existence of inflammation, unless there were symptoms during life or other marked effects of the inflammatory process in the alimentary canal. It can be no sign of poisoning, unless the presumption be supported by evidence from symptoms, or by the discovery of the poison : the absence of poison may however be sometimes easily explained by circumstances.

The redness of the stomach, in cases of poisoning, is so speedily altered by putrefaction, when circumstances are favourable to this process, as to render it impossible for a witness to speak with any certainty upon its origin. Putrefactive infiltration from the blood contained in the adjacent viscera and muscles, will give a reddish coloured appearance to a stomach, otherwise in a healthy condition. Great dispute has arisen as to how long a time the redness of the stomach in irritant poisoning, will be recognizable and easily distinguished from putrefactive changes. It is, perhaps, sufficient to say, that no certain rule can be laid down on the subject : it must be left to the knowledge and discretion of the witness. I have distinctly seen the well-marked appearances of inflammation produced by arsenic in the stomach and duodenum, in an exhumed body twenty-eight days after interment. (*Reg. v. Jennings.* Berks Lent Ass. 1845.) See on this question, a case of suspected poisoning by Orfila, Annales D'Hyg. 1839. i. 127. If however there be the least doubt on the origin of the discoloration, it would be unsafe to rely upon it, as evidence of poisoning. In the *Boughton* case,—the medical witnesses stated that the stomach and viscera of the deceased were red, and presented the appearance of inflammation. In answer to a question put to him on the subject, the Crown witness, Dr. Rattray, said, that "*the post-mortem appearances confirmed his opinion of poisoning by laurel-water, so far as he might be allowed to form a judgment upon appearances so long after death.*" This very ambiguous answer led to the following cross-examination by the counsel for the prisoner.

C. "By your putting your answer in that way, do you or do you not mean to say that all judgment in such a case is unfounded?"

W. "I cannot say that, because from the analogy between the appearances in that body, and those distinguishable in animals killed by the poison I have just mentioned, I think them so much alike, that I am rather confirmed in my opinion with respect to the operation of the draught."

C. "Those bodies were *instantaneously* opened?"

W. "Yes, so much so, that there was the peristaltic motion of the bowels upon their being pricked."

C. "This," (the examination of deceased's body) "was upon the *eleventh* day after Sir Theodosius's death?"

W. "Yes."—(Report of the trial of Donellan).

Here it will be seen that the witness was comparing the appearances in the bodies of dogs *immediately* after they had been killed by poison, with those met with in the stomach of a person who had died *eleven* days before, and whose body had been buried and exhumed. The comparison was wrong as a matter of medical evidence; but even had it been correctly made, it would have proved nothing in relation to the poison administered, (laurel-water,) the effect of which is not to produce redness of the stomach.

Ulceration.—In irritant poisoning, the stomach is occasionally found ulcerated; but this is, comparatively speaking, a rare occurrence. In such cases, the mucous membrane is removed in small distinct circular patches, in the edges of which, the poison (arsenic) is often found lodged. Ulceration of the stomach is perhaps a more common result of disease, than of the action of poison. As a consequence of disease, it is very insidious, going on often for weeks together, without giving any indication of its existence, except perhaps slight gastric disturbance, with occasional nausea, vomiting and loss of appetite. In this case the ulceration is commonly seen in small circumscribed patches. It is worthy of remark, as one means of diagnosis, that ulceration has never been known to take place from arsenic or any irritant poison, until symptoms indicative of poisoning have occurred. In ulceration from disease, the mucous membrane is commonly only reddened in the neighbourhood of the ulcer. In ulceration from poison, the redness is generally diffused over other parts of the stomach, as well as over the duodenum and small intestines. A case occurred in Guy's Hospital, some years ago, where, with a small circular patch of ulceration near the cardiac opening, the whole mucous membrane was red and injected:—but this singular condition of the stomach, so closely resembling the effects of an irritant poison, was unaccompanied by any marked symptoms during life. The history of a case previous to death will thus commonly enable us to determine, to what cause the ulceration found, may be due. Care must be taken to distinguish ulceration from corrosion. Ulceration is a vital process, the substance of a part is removed by the absorbents as a simple result of inflammation. Corrosion, on the other hand, is a chemical action;—the parts are removed by the immediate contact of the poison: they are decomposed:—their vitality is destroyed, and they combine with the corrosive matter itself. Ulceration requires time for its establishment, while corrosion is generally an instantaneous effect.

Softening.—The coats of the stomach are sometimes found so soft, as to yield and break down under very slight pressure, and this may be the result either of poisoning or of some spontaneous morbid change in its structure. As this change in the stomach, when caused by poison, is commonly produced by those substances only, which possess corrosive properties, it follows that in such cases, traces of their action

will be found in the mouth, fauces and œsophagus. In softening from disease, the change will be confined to the stomach alone. When softening is really caused by an irritant poison, it is generally attended by other striking and unambiguous marks of its operation. Softening is not to be regarded as a common character of poisoning: it is only an occasional appearance. I have met with a case, in which the coats of the stomach were considerably hardened by sulphuric acid. Softening can never be inferred to have proceeded from poison, unless other well-marked changes are present, or unless the poison be discovered in the softened parts. The stomachs of infants have been found softened from natural causes:—such cases could not be mistaken for poisoning, since the history during life,—the want of other appearances indicative of poisoning, and the total absence of poison from the viscera, would prevent such a suspicion from being entertained.

PERFORATION.—The stomach may become perforated either as a result of poisoning or disease.

Perforation from poisoning.—This may occur in two ways: 1. By corrosion; 2. By ulceration. The perforation by *corrosion*, is by far the most common variety of perforation from poisoning. It is occasionally witnessed where the strong mineral acids have been taken, especially the sulphuric acid:—the stomach in such cases, is blackened and extensively destroyed,—the aperture is large, the edges rough and irregular, and the coats become easily lacerated. The poison escapes into the abdomen, and may be readily detected by chemical analysis. The perforation from *ulceration*, caused by irritant poison, is but little known. There are, so far as I know, only three instances on record. In a great number of poisoned subjects examined during many years past at Guy's Hospital, not a single case has occurred. It must then be looked upon as a very rare appearance in cases of irritant poisoning.

Perforation from disease.—This is by no means an unusual occurrence. Many cases of this description, will be found reported elsewhere. (Guy's Hosp. Rep. No. 8.) It is invariably fatal when it proceeds so far that the contents of the stomach escape into the abdomen; but sometimes the stomach becomes glued to the pancreas during the ulcerative process, and then the individual may recover. Several specimens of this kind of adhesion have been met with in post-mortem inspections. The symptoms from perforation commonly attack the individual suddenly, apparently while enjoying perfect health. Thus then these cases may be easily mistaken for those of irritant poisoning. The principal facts observed with regard to this formidable disease, are the following:—1. It often attacks young females from eighteen to twenty-three years of age. 2. The preceding illness is extremely slight, sometimes there is only loss of appetite with uneasiness after eating. 3. The attack commences with a sudden and most severe pain in the abdomen, generally soon after a meal. In irritant poisoning, the pain

usually comes on gradually, and slowly increases in severity. 4. Vomiting, if it exist at all, is commonly slight, and is chiefly confined to what is swallowed. There is no purging:—the bowels are generally constipated. In irritant poisoning, the vomiting is usually severe, and diarrhea seldom wanting. 5. The person dies commonly in from eighteen to thirty-six hours:—this is also the average period of death in the most common form of irritant poisoning, i. e. by arsenic;—but in no case yet recorded, has arsenic produced perforation of the stomach, within twenty-four hours; and it appears probable that a considerable time must elapse before such an effect could be produced by this or any irritant. In two cases of perforation of the stomach from disease in females, reported by Dr. Seymour to the Med. Chir. Soc., November, 1843, the one proved fatal in ten days, the other in a fortnight after the occurrence of the supposed perforation. The ulcers in the stomach were found to communicate with cysts. 6. In perforation from disease, the symptoms and death are clearly referable to peritonitis. 7. In the perforation from disease, the aperture is commonly of an oval or rounded form, about half an inch in diameter, situated in or near the lesser curvature of the stomach, and the edges are smooth. The margin of the aperture is often blackened, and the aperture itself is funnel-shaped from within outwards, i. e. the mucous coat is the most removed, and the outer or peritoneal coat the least. The coats of the stomach, round the edge of the aperture, are usually thickened for some distance; and when cut, they have almost a cartilaginous hardness.

These characters of the aperture, will not indicate, whether it be the result of poisoning or disease; although the absence of poison from the stomach, with the want of other characteristic marks of irritant poisoning, would enable us to say, that disease was the cause. Besides, the history of the case during life, would materially assist us in our diagnosis. The great risk in all these cases, is that the effects of disease may be mistaken for those of poisoning; for we are not likely to mistake a perforation caused by irritant poison for the result of disease.

It is here necessary to point out one insidious form in which perforation of the intestines may present itself, and cause fatal peritonitis. This is by the formation of an ulcerated aperture in the appendix vermiformis cœci, of which two cases have been communicated to me by a former pupil, both occurring in young men. The perforation was produced in these instances by the pressure of a hard substance lodged in the extreme end. In one instance, I analysed this hard concretion, and found it to consist of inspissated mucus, biliary matter, and a large quantity of carbonate of lime. It was of an irregular form and structure, and about the size of a large pea. In both instances death was caused by peritonitis, produced by extravasation of the contents of the intestines, and the aperture was so small that it might have been easily overlooked.

Spontaneous Perforation.—The stomach is occasionally subject to a spontaneous change, by which its coats become softened and give way. As the extravasation of the contents of the organ in such a case never gives rise to peritoneal inflammation, and no symptoms occur prior to death to indicate the existence of so extensive a destruction of parts, it is presumed to be a post-mortem change, and the stomach is supposed to undergo a process of solution soon after death. It is commonly attributed to the action of the gastric juice, but the real cause of the change is not explained. It is so extremely rare, that during a period of fourteen years, there is the record of only one case occurring in the very numerous inspections made at Guy's Hospital. I have lately (January, 1845) met with an instance in a child between two and three years of age. It was seized with convulsions, became insensible, and died twenty-three hours afterwards. After death, the cardiac end of the stomach was found destroyed to the extent of three inches, the edges were then softened and blackened. There was no food in the stomach, nor had anything passed into the organ for thirty-two hours before death! For a full account of this case, see Med. Gaz. xxxvi. 32.

The aperture is large, irregular, and ragged at the edges, having the appearance of being scraped; the mucous membrane of the stomach is not found inflamed. It can only be confounded with perforation by the action of corrosives, bnt the well-marked symptoms during life, and the detection of the poison after death, together with the changes in the fauces and œsophagus, will at once indicate the perforation by poison.

The only case in which any mistake is likely to occur, is where, conjoined with the discovery of perforation after death, there may have existed symptoms of irritation in the alimentary canal during life. It is possible that a person may die under symptoms somewhat resembling irritant poisoning, and after death the gastric secretion may destroy the parietes of the stomach; but such a singular combination of circumstances must be most unusual. That, however, signifies little in a legal point of view, for persons charged with the crime of poisoning, are frequently acquitted on the barest medical possibilities. One case of this doubtful character is on record. I allude to that of *Miss Burns*, for the murder of whom, by poison, a Mr. Angus of Liverpool was tried in the year 1808. It is not necessary to enter into the particulars of the case; since the post-mortem appearances are imperfectly described in the report. Although the symptoms resembling irritant poisoning, under which the deceased laboured, were not accounted for, yet there was great reason to believe that they were not connected with the perforation found in the stomach, which, on the whole, bore the characters assigned to that produced by the gastric secretion. The charge of poisoning was not sustained by chemical or pathological evidence, and the prisoner was acquitted. The evidence given on this trial is well worthy of the attention of every medical practitioner. It shows on what a nice balance of proofs charges of poisoning sometimes rest, and

how important it is that a medical jurist should be acquainted with all the circumstances under which perforations of the stomach may occur.

3. Chemical Analysis.—The last branch of the evidence of poisoning in the dead subject is that derived from the chemical analysis of the viscera, or their contents. This of course will tend to confirm or disprove the inference of poisoning drawn from the preceding characters. It will be proper to consider the value of this kind of evidence in another chapter.

CHAPTER VI.

ON THE EVIDENCE OF POISONING FROM CHEMICAL ANALYSIS.

It has been supposed that chemical evidence of poisoning was always necessary, and that the *corpus delicti* was not made out, unless the poison were discovered by a chemical analysis. This, however, is not a correct view of the matter. There are many poisons which cannot, at present, be detected by chemical analysis, and among those susceptible of analysis, there are numerous circumstances which may occur to prevent their detection in the food, the vomited matters, or the contents of the viscera in the dead. If such a rule of law were adopted, it would therefore allow many criminals to go unpunished. All that is required legally, is that there should be satisfactory proof of a person having died from poison;—the discovery of poison in the body is not necessarily evidence of its having caused death, nor is its non-discovery, evidence that death has not been caused by it. If by the symptoms and post-mortem appearances, with or without moral circumstances, it can be made clear to the minds of a jury, that death has been caused by poison, nothing more is required; the evidence from chemical analysis may be then safely dispensed with. In cases of murder, the law commonly requires that the body of the deceased should be produced, in order that the cause of death may be verified; but this is not absolutely necessary, for several convictions for murder have very properly taken place where the bodies of the murdered persons have not been forthcoming. Thus then we must not suppose that a charge of poisoning cannot be sustained without chemical evidence being produced of the nature of the substance taken. The fact of a poison having been used, as well as its nature, may be determined from other circumstances. In the case of *Donellan* already referred to, the only evidence of the nature of the poison used, was the odour perceived by a non-professional person. The effects which followed, made up for the want of clear chemical proof of its nature.

As some objections have been offered to the propriety of a conviction in this case, I may refer to two others:—one the case of a man named *Thom*, tried at the Aberdeen Autumn Circuit, 1821, for poisoning a person named Mitchell with arsenic. No trace of poison could be detected; but a conviction very properly took place on evidence from symptoms and post-mortem appearances, coupled with moral circumstances. A still more recent instance occurred at the Monaghan Lent Assizes, 1841, where a woman was convicted of poisoning her husband, although the nature of the poison could not be determined by the most carefully conducted chemical analysis. The poison was considered to have been aconite. See also *Humphrey's* case, Aberdeen Sept. Circ., 1830.

On the other hand, where the other branches of evidence are weak or defective, the detection of the poison by chemical analysis becomes of such importance, that if it fail, an acquittal will follow. Conjoined with strong moral circumstances, chemical evidence will often lead to conviction where post-mortem appearances are entirely wanting, and the evidence from symptoms is very imperfect. The great value of chemical evidence in otherwise doubtful cases of poisoning, was never so strongly shown as at the trial of Mary Ann Burdock at Bristol, in 1835, for poisoning *Clara Smith* with orpiment. The deceased had been dead and buried fourteen months. The body was exhumed, and the poison discovered in the stomach and viscera. It must be clear to all medical jurists, that had it not been for the detection of the poison in the viscera after this long period of time, the prisoner would most probably have been acquitted. We cannot therefore be surprised to find that it is this branch of evidence which is deemed most satisfactory to the public mind, and which is earnestly sought for by our law authorities on charges of poisoning. The reason is, that in most cases, it demonstrates at once the means of death; while symptoms and post-mortem appearances are, as we have seen, fallible criteria, unless many circumstances, often difficult of appreciation, are fully considered by the medical witness. Many coroners are not sufficiently aware of the importance of this branch of evidence in cases of suspicious death. In two cases of recent occurrence the fact of poisoning was established by a chemical analysis of the contents of the stomach, although verdicts of natural death had been previously returned in both. One of these cases subsequently came to a trial which terminated in the conviction of the accused party. (The *Queen v. Jennings*, Berks Lent Assizes, 1845.) Chemical analyses of the contents of the stomach should be more frequently made.

Before proceeding to the analysis of any suspected substance, we should, if possible, make ourselves fully acquainted either with the symptoms or post-mortem appearances, or both, observed in the person suspected to have been poisoned. We may by a knowledge of these facts determine, à-priori, whether we shall have to search for a narcotic, irritant, or corrosive poison. The kind of poison may often be predicted from the symptoms and post-mortem appearances, and

our analysis directed accordingly. I have known more than one instance, where an irritant poison has been sought for in the contents of the stomach, when every fact connected with the death of the party, as well as the rapidity with which death took place, tended clearly to show that if any poison had been used, it must have been one of the pure narcotics. It is not unusual to find the examination of medical witnesses misconducted in Courts of law, in relation to the effects of poisons. The deceased may have died from a narcotic, while questions relative to the action of irritants alone, will be put by the counsel for the prosecution and defence.

The chemical evidence may be divided into several branches. The analysis may extend 1. To the pure poison. We may be required to state the nature of a substance (part of the poison administered) found in the possession of a prisoner. 2. The analysis may be confined to a part of the substance of which the affected party partook, and here the poison is usually mixed up with liquids or solids of an organic nature. The steps of the analysis become then rather more difficult. *a.* There may have been various substances combined in a meal, and the poison have been mixed with one substance only. This will show the necessity for examining separately the various articles used at a meal, if we wish to discover the real vehicle of the poison. *b.* Symptoms of poisoning may occur after the eating of a pudding. A part of the pudding may be analysed, and no poison discovered; because the poison, instead of being incorporated with the dough, may have been loosely sprinkled like flour over the exterior only. *c.* A similar circumstance may occur in the poisoning of a dish of meat. The gravy may be poisoned, and not the meat. A case of this kind occurred to Dr. Christison. A whole family was attacked with symptoms of poisoning after a meal on roast beef. The meat was examined, but no poison could be discovered. It was then ascertained that the poison had been mixed with the gravy, and those who had taken the meat without the gravy, suffered but slightly. In one instance, which occurred lately, arsenic was placed instead of salt on the edge of the plate of the deceased. No other person experienced symptoms of poisoning after the meal, except the child who ate out of that plate.

In the case of *Bodle,* tried in 1833, the deceased was proved to have been poisoned by arsenic administered in coffee. The coffee was kept ground in a bottle, to which every one of the family had access; and there could be but little doubt, from the circumstantial evidence, that the poison had been mixed with the coffee in this bottle. A careful examination of the coffee remaining in the bottle was made, but no trace of arsenic could be detected. The poison had most probably been mixed with the *upper stratum* only of the powdered coffee, and the whole of the poisoned portion had been used for breakfast. A remarkable fact was brought out in the case of *The Queen* v. *Edwards,* (Central Criminal Court, November, 1844.) The deceased, it was stated, had died from drinking part of the contents of a bottle suspected to contain sugar of lead,—but it was roved that some of the same

liquid had been drunk by another person the night previously without any injury resulting. The medical witness explained this by saying that the poison existed as a crust in the bottle which might have been detached in one case and adherent in the other. A somewhat similar case is given under the section on CARBONATE OF LEAD. See that compound, post.

These facts are of some medico-legal importance: they will often enable a witness to explain certain anomalies in cases of poisoning. By bearing them in mind, it is easy to understand, how it is that one or two persons only will suffer at a meal made in common or on the same article of food, while others will escape.

3. The chemical analysis may be directed to the matters *vomited* and evacuated. In irritant poisoning, a large quantity of poison is often expelled in this way, and may be detected especially in the matter first vomited.

4. If death has ensued, an analysis of the contents of the stomach and intestines must be made. Supposing no vomiting to have occurred, or that this has been slight, then we may expect to find abundant traces of the poison in the viscera. If no poison should be found in the stomach, the contents of the duodenum and the other small intestines must be separately examined.

It is obvious that one or several of these sources of chemical evidence may be wanting, and it is rare in any one case of chemical poisoning that all are open to the medical witness. The detection of poison in the vomited matters during life, and in the viscera after death, is of course the most satisfactory kind of chemical evidence; since cæteris paribus it is a clear proof of poison having really been taken. It is difficult to admit the supposition that it should have been designedly introduced after death; besides, in such a case, the absence of all marks of vital reaction, and of any symptoms during life indicative of poisoning, would remove any such suspicion. The presence of poison in the viscera, with such marks of vital reaction as are known to be produced by the particular substance, as for instance, inflammation in the case of the irritants, affords presumptive evidence of death from poison, open to be rebutted by other proofs of death from disease, under which the deceased might have been labouring at the time.

But let us take the case, that chemical evidence is entirely wanting, and that no poison is detected under any of the circumstances mentioned: if there be other facts to render death from poisoning probable, we must endeavour to explain why this important branch of evidence has failed. There are few medical jurists who have not met with cases where, although undoubtedly death was occasioned by poison, whether irritant or narcotic, not a trace of the substance could be detected in the solids or liquids of the body. The non-discovery of poisons in cases of poisoning may depend

1. *On the nature of the Poison.*—In the present state of our knowledge, chemistry, with few exceptions, furnishes us with the means of identifying with certainty a mineral poison only. The greater number

of vegetable poisons are beyond the reach of chemical analysis. Botanical characters may sometimes serve to point out the nature of the substance; but only in those instances where the plant has been swallowed with its leaves or other parts in the state of fine powder. If the extract or inspissated juice has been administered, or if the poison were in the form of infusion, tincture or decoction, a chemical analysis will commonly be of no avail. The same remarks apply to the powerful alkaloids extracted from vegetables. It is true, that there are tests for morphia, strychnia and a few others; but these are on the whole unsatisfactory as a basis for chemical evidence of poisoning.

Again, poisons which are of a highly *volatile* nature, may be speedily dissipated; so that in a few hours or a few days after death, none may be discovered. Alcohol is well known to pass away so rapidly, that no spirituous odour may be perceived in the contents of the stomach, although the individual may have died speedily, and the body be inspected six or eight hours after death. Prussic acid may be in like manner rapidly dissipated. (See PRUSSIC ACID.)

2. The non-detection of poison in the viscera may be owing to its having been expelled by excessive *vomiting* and *purging*. In all such cases, however, the poisonous substance ought to be found in the vomited matters. In two instances of poisoning by sulphuric acid,—in two of arsenic, and in one of oxalic acid, although death took place with the usual rapidity, I could not detect any of the respective poisons in the stomachs of the deceased. Similar cases are to be found reported in most works on medical jurisprudence.

It may, however, be fairly inferred that in all cases of irritant poisoning, where the vomiting and purging have been slight, some portion of the poison ought to be found in the body. If none be present, it may be a question whether death was really due to poison. It is not likely that a common dose of arsenic would be entirely removed by absorption. (See the case of the Queen *v.* Hunter, Liverpool Lent Assizes, 1843.)

3. The *form* in which the poison is administered. Solid poisons are usually detected without difficulty, because they are in general administered criminally in very large doses; but in cases of chronic poisoning. i. e. where the substance is administered in small doses at long intervals, chemical analysis will sometimes fail; for the poison may become absorbed and eliminated. The late researches of Orfila have proved that most metallic irritants enter into the circulation, and become diffused over the body, even to the extremities of the fingers and toes. Orfila has discovered that arsenic especially is liable to be excreted with the urine. In this way, if the dose be small, and taken in a state favourable for absorption, no trace of the substance may be found in the body, unless the muscles and viscera be analysed.

It cannot be denied, that the great facility with which chemical analysis is applied to the detection of most irritant poisons, is due to the ignorance of those who criminally administer them. A mineral poison is commonly given in the form of a loose powder, undissolved;

and is then easily susceptible of analysis. Instances of extraordinary depravity have, however, occurred in which persons have shown themselves to be acquainted with these facts, and they have endeavoured so to destroy their victims, as to frustrate the usual means of detection. A case was tried at Mayence in March, 1835, in which the evidence clearly proved, that the prisoners had poisoned the deceased and several persons previously, by administering to them, arsenic, in a saturated solution in water. One of them confessed that she had boiled the poison in water, allowed it to cool, filtered the solution, and then administered it by small quantities at a time in wine, milk, gruel and other liquids. On one of these occasions, the dose of poison was so large, that it operated with fatal rapidity—a circumstance which led to the detection of the crime. As might have been anticipated, not a trace of arsenic could be discovered on analysing the contents of the viscera of those who had perished in this manner. The quantity of a mineral poison removed by absorption is, however, in all cases extremely small. A case somewhat similar is related by Dr. Christison, as having occurred in Scotland (p. 319.) The celebrated Acqua Toffana appears to have been a pure solution of arsenic. Prussic acid may also entirely disappear by absorption. An instance has lately been communicated to me where a man by mistake swallowed forty-five drops of an acid of two per cent. He lay insensible for four hours. He then vomited and recovered. The vomited matters had not the least odour of Prussic acid.

4. Lastly, some poisons may be removed by *treatment,* as under the administration of antidotes and the use of the stomach-pump. Others appear to undergo a change analogous to digestion from the action of the secretions of the stomach upon them. These are chiefly poisons belonging to the organic kingdom; and this has been suggested by Dr. Christison as a reason why in many cases of rapid poisoning by opium, no trace of the poison has been discovered.

A chemical analysis is commonly directed in toxicology to the determination of two points;—1. Of the *nature* of the poison. 2. Of the proportion, or *quantity,* in which it has been taken.

The nature of the poison and the probable quantity administered, are usually stated in the indictment; but it is not absolutely necessary for conviction, that the substance thus stated, should be proved to have been that which was actually administered. The purposes of the law are considered to be fulfilled if the kind of death be substantially proved:—thus it is only necessary to prove that the person was poisoned. A man may be indicted for administering corrosive sublimate; but the medical evidence may show that the poison was in reality arsenic or prussic acid;—still the prisoner may be convicted of the crime, the variance in the means alleged being immaterial. This is, in many respects, fortunate; since a person may be convicted in spite of any imperfections existing in the original analysis.

The *quantity* of poison administered, is generally stated conjecturally; but it is sometimes in the power of a witness to give a

tolerably accurate statement of the quantity taken, when any portion of the original vehicle of the poison is discovered. Thus, all solid substances given for analysis should be first weighed;—and all liquids measured: a quantitative analysis may then be performed at any subsequent period. The chief question in law in regard to the quantity of poison is:—whether it was sufficient to destroy life, or to produce any serious effects? Thus, the malicious intention of a prisoner is often to be inferred from the quantity of poison existing in the substance administered. A case occurred some years since, in which a man was capitally indicted for administering oxalic acid with intent to murder. The poison was introduced into coffee, served for the prosecutor's breakfast. There could be no doubt of its presence; but on estimating the quantity, Mr. Barry discovered that it was only in the proportion of about ten grains to a pint, a quantity which he considered insufficient to produce any serious effects on the body. The prisoner was acquitted; but it is obvious, that had the proportion been an ounce to a pint, the malice of his act would have been apparent. This case shows that a medical jurist must not be content with merely determining the presence of poison in suspected liquids,—he should also determine the quantity. The law presumes upon the innocence rather than upon the guilt of an accused party, when the evidence fails in showing from the small quantity of the poison administered, that the act was malicious. If a man gave to another a few drops of sulphuric acid in a large quantity of water, we should not infer that his intention was to murder; but if he administered a large quantity of the acid in an undiluted state, the malice of the act would be at once apparent. Presumptions of this kind must, of course, be affected, as well by the nature of the poison, as by the moral circumstances adduced in evidence. A prisoner has sometimes alleged in his defence, that he did not know the substance to be a poison, and that he did not administer it with intent to kill. The law, however, properly infers that the highly destructive properties of such substances as arsenic or corrosive sublimate, must have been well known to the prisoner, if an adult, by common repute.

It need hardly be observed, that the *quantity found in the stomach* or viscera can convey no idea of the quantity actually administered; since more or less of the poison may have been removed by violent vomiting and purging as well as by absorption. But the quantity found in the stomach, even after a portion has been thus lost, is often more than sufficient to destroy the life of a human being. It is singular that, notwithstanding this very obvious cause for the removal of a poison from the stomach, barristers should so frequently address the inquiry to a medical witness—whether the quantity of poison found in the viscera was sufficient to cause death? Whether this question be answered in the affirmative or negative, is a matter which cannot at all affect the case, since either no traces of poison or but a very small quantity may be found in the viscera, and yet the deceased may have assuredly died from its effects. Thus, then, whether much or

little be found, the object of this question is not very apparent; since the fact of death having been caused by poison does not, in the least degree, rest upon the precise quantity which remains in the dead body. It has been truly remarked by Orfila, in regard to arsenic, and it equally applies to all poisons, that that portion which is found in the stomach, is not that which has caused death; but the *surplus* of the quantity which has produced fatal effects by its absorption into the system.

This question is one of more importance than may at first sight appear. There is scarcely a trial for criminal poisoning, in which it is not put to a medical witness either by the judge or the counsel for the prosecution or defence—Supposing poison is found in the stomach, but not in sufficient quantity to destroy life,—is it to be assumed that the person did not die from its effects? This would be equal to laying down the doctrine, in face of the most indisputable evidence to the contrary,—that poisons when taken into the body, are never liable to be expelled by vomiting or purging, or to be removed from the stomach by absorption. The real object of the toxicologist is to discover the poison by clear and undoubted evidence. If more than sufficient to cause death be discovered, then the dose must have been larger than was necessary; but if this proof be always required, what is to become of those cases of criminal poisoning in which the prisoner administers a dose only just sufficient to destroy life? The accused parties should either be acquitted, or one cannot see the object of putting such a question in any case. Orfila has lately discussed this subject most ably. (See Ann. D'Hyg., 1845, i. 347.)

In conducting an analysis, the smallest possible quantity of the suspected liquid or solid, should be used. If all were used at one operation, doubts might afterwards arise in the mind of the analyst, which it would be out of his power to remove. By care and ordinary precaution, a few grains will give results as satisfactory as those obtained from several ounces: and there is this additional advantage, that a portion is saved for the corroborative experiments of other analysts, or for correcting those which may have been previously performed.

With respect to the minute quantities of poison which may be detected by chemical process, some remarks will be made hereafter. It is, indeed, fortunate for the ends of justice, that those poisons commonly selected by criminals, may be discovered when existing in proportions so small as to excite wonder and incredulity in those who are not much acquainted with this department of science. The opinion of an experimentalist as to the presence of poison is never based upon the quantity actually found; for the results may be as infallible with a grain, or even the hundredth part of a grain of some substances, as with many ounces. All tests have a limit to their action; and when they act obscurely, or cease to act, the witness is bound to state that the chemical evidence has failed. Arsenic may be, however, safely inferred to be present when we obtain a quantity of the metal scarcely ponderable in the most delicate balance. We

might go on with the experiment, and obtain from other portions still larger quantities of the metal; but the evidence of the presence of the poison would not be, chemically speaking, rendered more conclusive. A toxicologist merely obtains sufficient to enable him to speak safely to the presence of the substance:—what the weight or other physical properties of the quantity so obtained may be, is a matter of no moment to him. It is customary for some medical witnesses to say that they only obtained *feeble evidence* of a poison by the application of tests. The use of these terms is liable to give rise to an erroneous impression. Either there is chemical proof of the presence of poison or there is not:—the law knows of no intermediate stage of evidence, nor will it accept it as proof; and a witness will assuredly expose himself to a severe cross-examination who makes use of this ambiguous language upon a question of such vital importance. The tests may act upon a very *small* quantity—but the results should not in any case be doubtful; they must be certain and decided, or they are worth nothing. The quantity of poison to which the tests are applied, is left entirely to the judgment of the witness.

If a practitioner has not been in the habit of analysing poisons, it is advisable, before he commences the analysis of the substance handed to him, that he should operate several times upon a portion of the same kind of poison as that which is suspected to have been administered. In the employment of chemical tests, it is especially necessary to determine that they are pure before the analysis is commenced. Arsenic may be contained in the sulphuric or muriatic acid used in an analysis of this poison; and sulphuric acid may be pronounced to be present in the stomach when it may have been contained in the nitric acid employed in the analytical process.

During the examination of a suspected substance, a practitioner is often pressed to give an opinion respecting its nature before the steps of the process are complete. This may arise from the anxiety or curiosity of those who are interested in the proceedings. There is a rule, however, which it appears to me, should always be followed on these occasions; namely, that no opinion whatever should be expressed until the whole of the analysis is complete. It often happens in the hands of the ablest analyst, that the last steps of a process lead to a result very different from that which was anticipated at the commencement. The truth is:—it is not by one character, but by many, that a poison is identified; and, therefore, a suspicion derived from a few incipient experiments, is very likely to be overthrown by continuing the investigation. In the *Boughton case*, Dr. Rattray gave an opinion in the first instance, that the poison administered to the deceased was arsenic; but he subsequently attributed death to laurel-water. A case occurred, within my knowledge, where arsenic was pronounced to be present when sulphuric acid was really the poison. In another case, tried at the Kingston Assizes in 1832, the medical witness admitted that at the coroner's inquest he stated the poison to be arsenic, but by subsequent experiments he found that it was oxalic acid. And

in a case which has but recently occurred (February, 1845,) the poison was at first stated to be oxalic acid, but on a more careful examination, it was shown to be arsenic! Coroners are not sufficiently careful in selecting persons to conduct analyses of this kind; hence it is by no means surprising that such mistakes should be frequently made.

This mistake respecting the nature of the poison not merely impedes the course of justice by throwing a doubt upon evidence which ought to be, beyond all question, clear and satisfactory; but it seriously affects the reputation of a witness. It entirely arises from his giving an opinion before he is justified from the facts in so doing. It is, I think, a well-marked line of duty to be pursued on these occasions;—1. That no opinion should be formed from a few experiments: and 2. That none should be expressed until the analysis is complete. It is obvious that, if a man be compelled to admit in cross-examination at a trial for poisoning, that he has been once mistaken on a question so important and requiring so decided an answer, a jury may be easily induced to believe that the witness may have made a second mistake, and that his then positive opinion is of no more value than that which he first expressed, and afterwards retracted. On the danger of trusting to an imperfect chemical analysis, see Annales d'Hygiène, 1829, ii. 405. xxvi. 399. xxix 103. 474.

CHAPTER VII.

ON THE EVIDENCE OF POISONING FROM EXPERIMENTS ON ANIMALS.

Some toxicologists have enumerated experiments upon animals as one among the sources of proof in cases of poisoning. This kind of evidence rests upon the assumption, that poisons act on man and the lower animals in the same way. The observations of Orfila, however, tend to show that this is partially true with only two domestic animals, namely, the dog and the cat:—in all other cases, the results by no means accord. With respect to experiments performed on dogs and cats, I quite agree with the opinion expressed by M. Devergie (Médecine Légale, ii. 457) that they are in no case fitted to show the doses in which particular poisons are injurious or fatal to man—nor can they be safely trusted to prove the rapidity of action in different poisons. All that they are fitted for, is to enable us to ascertain whether a particular substance be injurious to animal life or not, but nothing farther. In *Donellan's* case, this kind of evidence was admitted to show the poisonous effects of laurel-water; and in *Freeman's* case, tried at Leicester in April, 1829, experiments on animals were received as evidence to prove how speedily prussic acid, in certain doses, will destroy life. These experiments rather led to the presumption

that the prisoner was guilty of the murder of a female by administering to her prussic acid; whereas, it was proved by circumstances, that he was innocent. An exclusive reliance upon such experiments is always liable to lead to erroneous medical evidence.

I shall here quote the results of some experiments on hydrocyanic acid lately made by Dr. Reid and Dr. Simson. In one, they gave *an ounce* of Scheele's prussic acid to a dog. The animal died in about one minute afterwards. Other dogs of the same size, to which about *six drops* of the same acid, from the same bottle, were given, died in the same period of time; although the dose in the last case was only one-eightieth part of the quantity given in the first experiment. The contractility of the heart was in none of the cases much impaired. (Ed. Med. and Surg. Journal, Oct. 1836, p. 500.) From these experiments, it is evident that no fair inference can be drawn of the relative effects of prussic acid on man and animals; for there is no agreement as to the action of the poison on the latter. Doses so widely differing from each other, were thus found to kill dogs of similar size within the same period of time.

When the question is merely, whether a suspected substance administered to another, is or is not poisonous, then we may occasionally be justified in resorting to this kind of evidence, in order to determine the fact. Most of the common poisons are, however, capable of having their presence easily demonstrated by a chemical analysis; and the properties of the substance will be thereupon known. But evidence of this description may be sometimes accidentally obtained, and then it will often dispense with a chemical analysis of the vehicle of the poison; and, indeed, may supply proof when no poison is discovered in the body of the deceased. An intelligent barrister related to me the following case which he was engaged in prosecuting on the Western Circuit some years since. A woman poisoned her husband with arsenic mixed in soup; and after the deceased had made a full meal, she threw the remainder out of a window into a farm-yard, thereby thinking to defeat all attempts at discovering the means which she had adopted to destroy her husband. It happened at the time, that a pig and several fowls were feeding under the window, and they ate up what fell on the ground. The whole of these animals died under symptoms of irritant poisoning. The husband also died:—no poison was detected in the stomach, although there were the traces of its action; but on opening the bodies of the animals, the medical witnesses found not only the appearances usually produced by irritant poisons, but arsenic itself was readily discovered in the viscera. This sort of evidence supplied that which was wanted to complete the case:—for while no poison was detected in the body, no portion of the poisoned soup could be procured. The prisoner was convicted and executed.

Good negative as well as affirmative evidence, may be sometimes obtained by the examination of the bodies of animals alleged to have been poisoned or actually poisoned. The following case is singular in

this respect:—A woman named *Higgins* was tried at the Warwick Summer Assizes in August, 1831, for the murder of her uncle by poisoning him with arsenic. Her guilt was throughout made very clear. It was proved that she had bought arsenic, and when required to account for the possession of the poison, she said that it was for the purpose of destroying vermin—the excuse resorted to by all murderers. She went, however, farther than this; and actually pointed out a dead mouse, which she said had been killed by the poison, in corroboration of her statement. This turned out to be an unfortunate part of her defence, for the medical witnesses showed that the mouse had not died from the effects of arsenic.

In the above cases, it will be seen that the evidence from the effects of poison was accidental, and ancillary to the main facts of poisoning. There is, however, one instance wherein evidence from experiments on animals cautiously performed, may be of equal importance on a criminal trial. I allude to the case where the poisonous substance is not of a nature readily to admit of a chemical analysis, as for example in substances belonging to the narcotic or narcotico-irritant class of poisons. In such a case, if the death of an animal take place under the ordinary symptoms of poisoning from the administration of a substance, part of which has been taken by the person whose life was then attempted, the evidence is very conclusive. This remark applies only to liquids or solids, which are made the vehicle of the poison,—not to any matters vomited or found after death in the stomach. The results here would be fallacious; because such matters may, without containing any poison whatever, give rise to vomiting and other symptoms in an animal. Foderè mentions a case, where a young child, after having partaken of some broth, fell into a state of stupor—lost all power of deglutition and foamed at the mouth. Some of the meat from which the broth was made, was given to a cat. The animal was seized with convulsive fits, alternating with stupor, and died in about five hours. It was rendered probable from the symptoms, as well as from an examination of the body of this animal, that these effects were caused by the introduction of a narcotic plant (hyoscyamus) into the broth.—(Méd. Lég. t. iv. p. 72.)

The following is, I believe, the most recent case in which this kind of evidence was received in an English court of law. A woman named *Sherrington* was tried at the Liverpool Spring Assizes in 1838, for the attempt to administer poison to one Mary Byers.

The evidence showed that the prisoner had sent to the prosecutrix a pudding by two young children. On the way, these children tasted it, and finding that it had an unpleasant taste, the prosecutrix was put on her guard. The pudding was sent to a surgeon to be analysed; but he could detect no poison in it. He suspected, however, that it contained a vegetable narcotic poison. He gave a piece about the size of an egg to a dog. In twenty minutes, the dog became sick—in forty minutes it lost the use of its limbs—and died in three hours. The prisoner was convicted.

CHAPTER VIII.

WAS DEATH CAUSED BY POISON? STATISTICS OF POISONING.

We have hitherto considered those facts which indicate in a disputed case whether or not poison has been the cause of death, in a previously healthy subject. We have supposed that the question of poisoning would turn simply on the affirmative or negative, and be established or disproved by the medical evidence. We meet with cases, however, in medico-legal practice, wherein the question presents itself under another aspect. Thus poison may have been taken or administered; the fact of poisoning may be established by the symptoms, post-mortem appearances, and the actual discovery of the substance in the food, in the vomited matters, and in the stomach of the deceased after death. All these points may be freely conceded; but the defence will rest upon the question, "Whether or not, the poison so administered, was actually the cause of death." To establish a charge of murder against a prisoner, it must be proved that poison was certainly and indisputably the cause of death. Any proof short of this, as the existence of mere probability, doubt, or suspicion, will of course lead to an acquittal. (See the case of *Pouchon*, Ann. D'Hyg. 1844, i. 431.) Thus, then, the medico-legal question would be:—Was death produced by poison, or by any other latent or secondary cause? And the witness will be required to state which of the two probable or co-existing causes, actually destroyed life. It may be remarked, that whenever we obtain those proofs of poisoning which have here been assumed to exist—the presumption is always in favour of poison: but it is not the less necessary for a medical jurist to determine, by a careful inspection of all the cavities of the body, whether death might not have been due to some insidious disease. In a case at all involved in doubt, negative evidence is as important as that which is affirmative; and a great error would be in many cases committed, if the examination of a body was stopped so soon as traces of the action of poison had been discovered. In *Donellan's* case, the head of the deceased, Sir T. Boughton, was not examined, an omission which might, had the general evidence been less clear, have led to difficulty; for the diseases from which it was alleged that the symptoms of the deceased might have proceeded (apoplexy and epilepsy) have their seat of morbid changes in that part of the body. An inspection of the head might, it is true, have thrown no light upon the question: but that is not the point—a medical witness must not omit this duty, and then excuse himself by saying that no morbid changes might have been found. The assumption will always be as much against him, as in his favour.

Cases in which the administration of poison is admitted, and death

referred to some other cause, although not common in Courts of law, are sufficiently frequent to demand the serious attention of the practitioner. The following appear to me to embrace the chief points on which a defence of this kind may rest.

1. DEATH MAY BE CAUSED BY IMPROPER FOOD.—It has been mentioned in a preceding chapter, (antè, p. 11,) that some kinds of food will cause death under symptoms resembling those of irritant poisoning. Such cases are not common, and they appear to depend often on idiosyncrasy or peculiarity of constitution. If poison be taken with such food, we might safely refer death to the former, provided the case took the usual course; and that death was preceded by all or a majority of the characters peculiar to the kind of poison taken. If any of these characters are wanting, this must weaken the evidence; but in most instances, it will be found that the symptoms of acute poisoning are so well marked as to extinguish those which may have depended upon the unwholesome food. Each case must be judged of by itself; no general rules for a decision can be laid down. Still it must be remembered, that death is not a very common consequence of unwholesome food, while it is the usual result of an active poison.

2. DEATH MAY BE CAUSED BY DISEASE.—This is a case which more frequently presents itself for our consideration; since poison is often administered to persons while labouring under disease. On a post-mortem examination, we may find, besides indications of poison, marks of extensive disease. When this is the case, the chief point to be considered is, whether the disease has advanced to that degree to account for rapid or sudden death; for this is one of the essential characters of acute poisoning. Should the history of the case be known, our judgment may be assisted by observing whether the symptoms preceding death were referrible to a diseased condition of the body or to poison. We cannot deny that singular coincidences may here occur. A man may have taken irritant poison, and yet death be occasioned by abscess in the brain, the lungs, by sudden hæmorrhage, or other causes. If the poison were of a nature to cut short life suddenly, we could not hesitate to refer death to it. Thus it is scarcely possible to admit, when prussic acid is the poison, that death should be referred to some diseased condition of the body found on a post-mortem examination. Whether the person be labouring under illness or not, the taking of this poison would be sufficient to account for death. The only exception would be where the prussic acid was in small quantity and might have been derived from some accidental source. (*Reg.* v. *Tawell,* Bucks Lent Assizes, 1845.) It is not always so easy, however, to determine this question in other cases of poisoning; for whether the substance taken be opium or arsenic, there is time for latent disease of the heart, brain, or lungs, to cut short life. The history of the symptoms preceding death, will enable us in general to return an answer. Without this history, or some strong corroborative evidence, a medical opinion can be little more than a conjecture.

Several complex cases of this description have occurred in reference to diseases of the stomach, the persons labouring under such diseases having had poison administered to them. Thus, the organ has been found perforated, and the question has been not so much what caused the perforation, as whether the perforation or the poison caused death.

The two following cases are related by Henke. A young girl died under suspicious circumstances, and an inspection of the body was ordered. The viscera were found healthy, except those of the abdomen. The stomach contained three ounces of a reddish coloured liquid. Its mucous membrane was of a dark red colour, and near the pylorus were several spots of a clear yellow hue. The contents of the stomach, on analysis, yielded arsenic. The account given by the mother, was that the deceased, some weeks before, had met with a fall, after which she complained of pain in her side. Shortly before her death, she said she felt ill, and vomited repeatedly,—she went to bed early, and died without being convulsed. The medical opinion was, that she had been poisoned; but the Court held, that the fact of poisoning was not proved, and the prisoner, charged with the crime, was acquitted. This case shows that there is great difficulty in forming a medical opinion, when there is no satisfactory account of the symptoms preceding death. In the case of *The Queen* v. *Jennings*, (Berks Lent Assizes, 1845,) the deceased was not seen by a medical man during life, but the stomach was inflamed, and arsenic was found in it. The only account of the symptoms preceding death was derived from the evidence of a young girl. The Court held that the fact of poisoning was established.

In the next case, a man was charged with having given to his wife, who had been for a long time ill, a small quantity of arsenic, in four different doses. The only symptoms that followed, were general illness and vomiting. Another, and stronger dose was then, it is supposed, administered; and after suffering severe pain, the woman died the day following. The body was inspected twenty-four hours afterwards. In the abdomen, the pancreas was found enlarged and in a scirrhous state, evidently proceeding from chronic disease. The lining membrane of the stomach was inflamed, and it presented gangrenous spots. It contained a greyish coloured liquid having a gritty feel. The uterus was in a state of scirrhous enlargement. The contents of the stomach, on analysis, were found to contain arsenic.

The medical opinion was that, notwithstanding the marks of extensive disease in the viscera of the abdomen,—the post-mortem appearances and the detection of the poison in the viscera, proved that the deceased had died from arsenic. The counsel, in defence, raised objections to this view, on the ground that the head had not been examined, and that the chemical analysis was defective. The Faculty of Leipsic being appealed to, overruled the objections. The diseased state of the pancreas, might, in their opinion, have given rise to vomiting, emaciation and death, but not to so sudden a death. The chemical analysis, although in some respects defective, sufficiently demonstrated the presence of arsenic in the viscera.—(Zeitschrift der S. A.) For a case

of supposed poisoning by nux vomica, but in which death took place from malformation of the heart, &c., see Med. Gaz. xxxvi. 19, also ib. p. 327.

The longer life is protracted after the supposed administration of poison, the more difficult becomes the decision; and it will be seen from the facts above related, that a question of this kind can only be satisfactorily settled, by a reference to the particulars attending each case.

This question may sometimes present itself to the medical witness under another form, namely, whether a person has died from a medicine exhibited in an improper dose or from disease. Thus a person enfeebled by age or disease, may be killed by a powerful drastic purgative. Infants may be killed by small doses of calomel. Several lives have been already lost by the effects of repeated doses of gamboge and aloes, exhibited in large quantities to enfeebled persons, under the form of Morison's pills, and convictions for manslaughter have taken place on this ground. The questions will be, 1. Whether the medicine or the disease caused death; or, 2. Whether the medicine merely accelerated death. The amount of guilt will depend upon the answers: and it will be for a jury to consider whether there were sufficient knowledge and caution employed by the person prescribing it.

The most simple remedies, improperly used, may thus act like poisons and destroy life. Such cases are commonly too well marked, to admit of much difficulty in deciding as to the real cause of death.

3. Death may have been caused by violence and not by poison.

A person who has taken poison, may be maltreated, and the question will arise whether the poison or the maltreatment was the cause of death. The solution of this question cannot in general be very difficult, when the history of the case is before us. Two instances of this kind are recorded by Christison, both of them quoted from foreign authorities. He suggests, what is highly probable, that their real nature would not have been discovered in this country, owing to the very superficial way in which inquiries into the causes of death are here conducted:—the rule being not to call for a post-mortem examination of a body unless there be suspicion, when in point of fact in numerous instances the inspection may be the only source from which suspicion of violence will proceed; and the very circumstance of holding an inquest implies something like suspicion as to the cause of death. (antè, p. 34.)

Wildberg was called upon to examine the body of a girl, who died while her father was chastising her for stealing. It was supposed by all, that the girl had died from the effects of the violence. On the arms, shoulders and back, many marks of violent treatment were found, and under some of them, blood was extravasated in large quantity. The injuries, although severe, did not appear sufficient to account for the sudden death. He, therefore, proceeded to examine the cavities, and on opening the stomach, he found it very much inflamed and lined with a white powder, which was proved to be arsenic. It turned out

that on the theft being detected, the girl had taken arsenic for fear of her father's anger: she vomited during the flogging, and died in slight convulsions. Upon this, Wildberg imputed death to the arsenic, and the man was exculpated. The cause of death may be easily assigned in such cases where the circumstances are known; but it is evident that without great care in conducting post-mortem examinations, the apparent may be sometimes mistaken for the real cause. For some interesting cases and good practical suggestions on this subject, see Belloc Cours de Med. Lég. 148.

4. Of two poisonous substances taken by the deceased, which caused death.

This question does not relate so much to the subject of compound poisoning, as to cases of the following kind, which may require careful medical investigation. A person may have had poison administered, while labouring under the effects of powerful medicine, or of some other poison. Thus a patient, while under a course of mercury, may have had corrosive sublimate administered to him with intent to murder. After a certain period, violent salivation with sloughing may ensue, and the patient die. Is death in such a case to be ascribed to the corrosive sublimate, or to the mercurial medicine previously administered? It may be necessary to state that death is sometimes produced by the severe salivation, induced by the preparations of this metal prescribed medicinally, in a mild form and in small doses.

In *Butterfield's* case, tried at Croydon, many years ago, this question incidentally arose. The prisoner was indicted for administering corrosive sublimate to the deceased. The immediate cause of death was profuse salivation; and this was referred by the medical witnesses, to the operation of the poison. It was proved, however, in the defence, that about two months previously to this attack, the deceased had been under treatment with some quack medicine, by which he was violently salivated; but this salivation had entirely ceased, and during the whole of the above-mentioned period, he had abstained from taking any mercurial preparation. It was at this time that the corrosive sublimate was supposed to have been secretly administered to him in small doses. The prisoner, however, was acquitted of the charge on the ground, that as mercury had been introduced into the system of the deceased by the quack medicine, the fatal salivation might have proceeded from a recurrent operation of this medicine, and not from the poison.

It is obvious that for the proper investigation of cases of this description the medical witness should be prepared with a full knowledge of the peculiar properties of most poisons—the doses in which they prove fatal—and the period of time within which they produce their symptoms and commonly destroy life.

In concluding this chapter, I wish to call the attention of the reader to some facts connected with the statistics of poisoning. In relation to medico-legal practice, this is a subject of some interest; because it will indicate to the medical jurist, what are the poisons that are most fre-

quently selected for the purposes of suicide and murder, and with the properties of which, it will be expected that he should be acquainted. Unfortunately very few tables of this kind, have been published; and those which have appeared are defective in many points. One of the best is that which was published some years since from the returns made by the coroners of England, of the number of inquisitions held in the years 1837 and 1838, wherein death was caused by poison.

The following is an abstract of the paper, which appeared in the Medical Gazette for November, 1839.

The number of deaths by poison (returned) in the two years above-mentioned, were 541, of which number 282 were males, and 259 females. The substances which caused death, may be taken in the following numerical order.

Opium		
Laudanum	133	
Opium	42	
Other preparations	21	196
Arsenic		185
Sulphuric acid		32
Prussic acid		27
Oxalic acid		19
Corrosive sublimate and mercury		15
Mixed or compound poisoning		14
Oil of bitter almonds		4
Poisonous mushrooms		4
Colchicum, nux vomica (of each 3)		6
Nitric acid, caustic alkali, tartar emetic, acet. morphia, strychnia, deadly nightshade, aconite, (of each 2)		14
Bichrom. potash, nit. silver, Goulard's extract, sulph. iron, mur. tin, hellebore, castor-oil seeds, savin, hemlock, cantharides, cayenne pepper, (of each 1)		11
		527
Unknown		14
		541

There can be no doubt that the number of deaths from poison which annually occur in England and Wales, are much greater than this table represents. The registrations of deaths although defective with respect to the number from individual poisons,—two only, i. e. arsenic and opium, being recorded, and these imperfectly,—show that the mortality from this cause, including overdoses of medicine, is greater than is commonly supposed. I here subjoin a table of the deaths from poison in 1840, drawn up from the sixth Annual Report of the Registrar General, (1844.)

The total number of deaths from this cause in 1840 are stated to have been 349, of which number there were 181 males and 168 females. The cases of suicide from poison were 161, being 87 females to 74 males,—the cases of accident or homicide were 188, being 107 males to 81 females. Of the 75 cases of poisoning by opium, 42 occurred in children under five years of age, a lamentable proof of the extensive mortality among children from the improper administration of this drug. These cases occur among the returned deaths from opium; but under the head of medicines improperly administered, three-fourths of the deaths took place among children under five years of age!

Opium	75
Arsenic	32
Other poisons, including medicines improperly administered	242
Total deaths from poison in 1840	349

It would be of considerable benefit to medical science if the poisons which caused death were more distinctly specified in the Registration returns. The poison or medicine should be stated as distinctly as the returns now made with respect to fatal diseases. The cases of poisoning by arsenic and opium in the above tables, are evidently understated.

CHAPTER IX.

ON POISONING BY THE IRRITANTS. SULPHURIC ACID. SULPHATE OF INDIGO.

IRRITANT POISONS may be divided into three groups—the non-metallic—the metallic—and those of an organic nature, i. e. derived from the vegetable and animal kingdoms. The non-metallic irritants comprise the mineral acids, oxalic acid, the alkalies, and their salts. According to strict chemical views, the alkalies and their salts should be placed among the metallic irritants; but it will be, in many respects, convenient to consider them in the same group with the acids. Besides, although they certainly have metallic bases, the demonstration of the existence of the metal, is never required at the hands of a medical jurist, as in the case of the true metallic irritants. Among the mineral acids, we shall first speak of poisoning by sulphuric acid.

SULPHURIC ACID (OIL OF VITRIOL.)—This poison is met with in commerce in two states, either concentrated or diluted. The concentrated acid is a heavy oily-looking liquid, often of a brown colour: it has a strong sharp acid taste—it powerfully reddens vegetable colours, and corrodes and destroys most kinds of organic matter.

SYMPTOMS.—When this poison is swallowed in a concentrated form, the symptoms produced, come on *immediately* or in the act of swallowing, for it is one of the most powerful corrosives. There is violent burning pain extending through the fauces and œsophagus to the stomach—the pain is often so severe, that the body is bent—retching and vomiting supervene, the latter accompanied by the discharge of shreds of tough mucus and of a liquid of a dark coffee-ground colour, mixed with altered blood. The mouth is excoriated, the lining membrane white, but after a time acquiring a grey or brownish colour—the cavity filled with a thick viscid sputa, rendering speaking and deglutition very difficult. Around the mouth and on the neck, may be found spots of a brown colour from the action of the acid on the skin. There is extreme difficulty of breathing, owing to the swelling and excoriation of the fauces and larynx;—and the least motion of the abdominal muscles is attended with increase of pain. These symptoms have been sometimes mistaken for disease. (Henke Zeitschrift der. S. A. 1843. ii. 284.) The stomach is so irritable, that whatever is swallowed, is immediately ejected, and the vomiting is

often violent and incessant. The vomited matters are acid, and if they fall on a limestone pavement there is effervescence, if on coloured articles of dress, the colour is sometimes altered or discharged and the texture destroyed :—on a black dress, the spots produced by the concentrated acid are brown and remain moist. An attention to these circumstances may often lead to a suspicion of the real nature of the case where the facts are concealed. In a case of attempted murder by sulphuric acid in beer, tried at the Lancaster Spring Assizes, 1844, the nature of the poison was suspected from the beer having corroded an apron on which a portion had become accidentally spilled. After a time, there is great exhaustion, accompanied by general weakness :—the pulse is quick and small ; the skin cold and covered with a clammy sweat. There is generally great thirst and obstinate constipation of the bowels ;—should any evacuations take place, they are commonly of a dark brown colour, almost black, arising from the admixture of altered blood. In some instances, there have been convulsive motions of the muscles, especially of those of the face and lips. The countenance is expressive of great anxiety, and the most dreadful suffering. The intellectual faculties are quite clear, and death usually takes place very suddenly, in from eighteen to twenty-four hours after the poison has been taken.

When the acid is *diluted,* the symptoms are much of the same character ;—but less severe. The vomited matters are not so dark coloured—in one case, they were almost colourless. The spots produced by the diluted acid on black cloth are red, becoming slowly brown.

The action of sulphuric acid on the fauces and œsophagus, is very energetic :—the lining membrane is stripped off in shreds, or peels off in large masses. In a case mentioned by Sobernheim, the lining membrane of the mouth, tongue and fauces, came off in one mass. In another related by Dr. Wilson, the patient, during a violent fit of coughing, brought up a large piece of sloughy membrane, which was found to consist of the inner coat of the œsophagus much thickened and very firm in texture. Its length was eight or nine inches, and its width, that of the œsophagus—it was of a cylindrical form and pervious throughout its whole extent. (Med. Gaz. xiv. 489.) This has been observed to occur in several other cases.

This poison may destroy life without reaching the stomach, a fact sometimes observed in the cases of young children. The larynx is then acted on :—the rima glottidis becomes closed by the swelling of the surrounding parts, and the child dies suffocated. In such cases, death takes place very rapidly. I have found that rabbits, to which this poison was given, died from this cause in the course of a few minutes. Mr. Quain met with the case of a child which became asphyxiated under these circumstances, while he was performing the operation of tracheotomy. The child was recovered by inflating the lungs, but died three days afterwards of bronchitis. On inspection, it was found that the acid had not even reached the œsophagus. (Lancet, October 29, 1836.) In this way sulphuric acid may cause death by suffocation

without descending so far as the stomach. A case of this description is related by Dr. A. T. Thompson, Lancet, June 10, 1837.

There is one instance on record in which this poison has destroyed life, where it was injected into the rectum by mistake for a clyster. The patient suffered the most acute pain, and died in the course of a few hours. (Med. Gaz. xvii. 623.)

Among the *secondary* symptoms of poisoning by this acid, may be mentioned profuse salivation. Desgranges observed a miliary eruption on the skin among the secondary consequences of poisoning by sulphuric and nitric acids. (Belloc Cours de Med. Leg. 120.)

POST-MORTEM APPEARANCES.—It has been already remarked, that these are not always to be found in the stomach; they may be confined to the region of the fauces and larynx. In an inspection of the body, the whole course of the alimentary canal, from the mouth downwards, ought to be examined; since it is in the œsophagus and fauces that we obtain strong evidence of the action of a corrosive poison. The discovery of the usual marks of corrosion in these parts, is always strongly corroborative of the signs of poisoning found in the stomach. In the inspection, the examiner must not omit to notice any spots on the skin produced by the action of the acid:—these are commonly of a dark brown colour, and are situated about the mouth and lips. The appearances met with in the body will vary according to whether death has taken place rapidly or slowly.

Supposing the case to have proved fatal within the usual period, the membrane lining the mouth is usually white, softened, and corroded. It is easily detached, and the parts beneath appear reddened. The mucous membrane of the fauces and œsophagus will be found in the same state, sometimes having a brownish or ash-grey colour. The corroded membrane of the œsophagus is disposed in longitudinal plicæ, portions of it being partly detached. The stomach, if not perforated, is collapsed and contracted. On laying it open, the contents are commonly found of a dark brown or black colour, and of a tarry consistency, being formed in great part of mucus and altered blood. The contents may or may not be acid, according to the time the patient has survived, and whether or not any treatment has been adopted. On removing them, the stomach may be seen traversed by black striæ, or the whole of the mucous membrane may be corrugated and of a dark brown or black colour. This blackness is not removed by washing. On stretching the stomach, traces of inflammation may be found between the rugæ, indicated by a deep crimson colour. On removing the blackened membrane, the red colour indicative of inflammation, may be also seen in the parts beneath. Both the dark colour and marks of inflammation are sometimes partial, being confined to insulated portions of the mucous membrane.

The small intestines are found more or less inflamed; and their contents are of the same nature as those met with in the stomach. When the stomach is perforated, the coats are softened, and the edge

of the aperture is commonly black and irregular. In removing the stomach, the aperture is apt to be made larger by the mere weight of the organ. The contents do not always escape; but when this happens, the surrounding viscera are attacked by the poison. In a case which occurred at Guy's Hospital, the spleen, the liver and the coats of the aorta, were found blackened and corroded by the acid which had escaped through the perforation. Dr. Craigie of Edinburgh thinks that even when there is no perforation of the stomach, the acid may find its way by transudation through the coats of the organ, in a very short time after it has been swallowed. In a case, where two ounces of the strong acid had been swallowed, and the person died in three hours and a half, he found that the peritoneum and the fluid contained in it, reddened litmus paper strongly. There was also a slightly acid reaction even in the serous membranes of the thorax. It does not appear, however, that the nature of this acid was determined by the application of any test.

When the poison has been taken in a diluted state, the marks of inflammation on the mucous membrane are more decided, and the charring is not so considerable. Nevertheless, the acid acts upon and blackens the blood in the vessels, as well as that contained in the stomach. When the individual does not die until after the lapse of eight or ten weeks, the mucous membrane of the œsophagus and stomach will be found entirely destroyed, and more or less extensively ulcerated. This leads to death by impairing the function of digestion. In several cases, the aperture of the pylorus has been found much contracted. Sometimes there will be stricture of the œsophagus. The common secondary causes of death in these cases, are fever, irritation, or exhaustion of the system.

It has been a disputed question, whether or not sulphuric acid is absorbed and carried into the circulation in cases of acute poisoning. M. Bouchardat considers that it is absorbed, and that it causes death by leading to a coagulation of the blood in the heart, aorta and large blood-vessels. He has found these coagula in two cases in considerable quantity; and in one of these, the lining membrane of the aorta was reddened. (Annales D'Hygiène, 1837, 362.) I have observed this last-mentioned appearance in one case, as well as the occurrence of coagula in two instances; but there does not seem to be any reason for believing that they result from the action of a portion of sulphuric acid absorbed. In analysing these coagula taken from persons who have been killed by sulphuric acid, I have never found a trace of that acid present in them. According to Orfila, the absorption of these mineral acids may take place owing to their compounds with albumen being soluble. There is no doubt that all these compounds are soluble in a large quantity of water, but they are insoluble when much acid is present.

Quantity required to destroy life.—The dangerous effects of this poison appear to arise more from its degree of concentration,

than from the absolute quantity taken. The quantity actually required to prove fatal, must depend on many circumstances. If the stomach be full when it is swallowed, the action of the acid may be spent on the food and not on the stomach, and a larger quantity might thus be taken, than would suffice to destroy life if the stomach were empty. In one case, one drachm of sulphuric acid destroyed life in seven days :—in another (*Humphrey's case*, Med. Gaz. viii. 77), about one drachm and a half destroyed life in two days. In one instance, a patient survived fifty-five hours after taking three fluid ounces of the concentrated acid. (Dr. Sinclair, Med. Gaz. viii., 624.) In another instance, related by Sobernheim, a man swallowed an ounce and a half of the concentrated acid, and yet slowly recovered from its effects. (Handbuch der Prakt. Tox. 384.) In a case quoted by Dr. Craigie, a young woman aged eighteen recovered after having taken *two ounces* of concentrated sulphuric acid. She was completely restored in about eighteen days. (Ed. Med. and Surg. Jour., April 1840.) Another instance of recovery after two ounces of the concentrated acid had been taken, is reported by Mr. Orr. (Med. Gaz. iii., 255.) The smallest quantity which I have been able to meet with as having proved fatal, was in the following case. Half a tea-spoonful of concentrated sulphuric acid was given to a child about a year old by mistake for castor-oil. The usual symptoms came on, with great disturbance of the respiratory functions, and the child died in twenty-four hours. The quantity here taken could not have exceeded *forty drops*. (Med. Gaz. xxix. 147.) It is, however, doubtful, whether this small quantity would have proved fatal to an adult. The smallest fatal dose which Dr. Christison states he has found recorded was one drachm. It was taken, by mistake, by a stout young man, and killed him in seven days. (Op. cit. 125.)

Period at which death takes place.—It has been already stated, that the average period at which death takes place in cases of acute poisoning by sulphuric acid, is from eighteen to twenty-four hours. When the stomach is perforated by it, it proves more speedily fatal. In one instance, reported by Dr. Sinclair, a child about four years old died in four hours—the stomach was perforated. When the poison acts upon the larynx, death may be a still more speedy consequence from suffocation; and it appears to be thus more rapidly fatal to children than adults. Dr. Craigie mentions a case in which three ounces of concentrated sulphuric acid destroyed life in three hours and a half; but the shortest case on record is, perhaps, that mentioned by Remer in Hufeland's Journal. In this instance, death took place *in two hours*. A case is reported by Mr. Watson, where a woman swallowed two ounces of the strong acid. She died in *half an hour*, but it appears that a quarter of an hour before death, she had made a deep wound in her throat, which gave rise to great hæmorrhage. The stomach was found very extensively perforated :—but it is highly probable that the wound accelerated death in this case.

On the other hand, there are numerous instances reported, in which

the poison proved fatal from secondary causes, at periods varying from one week to several months. One of the best authenticated cases of this kind occurred within the last few years to Dr. Wilson of the Middlesex Hospital, and is referred to by Mayo in his Outlines of Pathology. A young woman swallowed about a table-spoonful of sulphuric acid on the 4th of January, and died from its effects on the œsophagus on the 14th of November following. She gradually wasted away and died from innutrition. This was forty-five weeks, or *eleven months*, after she had swallowed the poison. There is no doubt that the acid might prove fatal at periods much longer than this, but the longer this event is protracted, the more difficult will it become to ascribe death to its effects.

TREATMENT.—Calcined magnesia or the carbonate of magnesia, finely levigated and mixed with milk or water, should be exhibited as speedily as possible. In the absence of these, finely powdered chalk or whiting may be given. Some have recommended diluted alkali or a weak solution of wood ashes, or even common soap and water. Sobernheim and Simon relate several cases in which the individuals were apparently saved by the free use of these alkaline diluents. There is often great difficulty in making the patient swallow :—the throat being swollen and blocked up with shreds of tough mucus and sputa. To obviate this, the stomach-pump has been employed in order to inject the liquids into the stomach. The use of this instrument ought, however, if possible, to be avoided ; since it is only likely to lacerate and perforate the structures which are softened and corroded by the acid. When there are symptoms of suffocation from an affection of the larynx, tracheotomy must be immediately resorted to.

On the whole, the antidotal treatment of cases of poisoning by sulphuric acid has not been very successful, the patient not having been seen sufficiently early by a medical man to give much hope of success :—for it must be remembered, the poison begins to act instantly on contact, and if the stomach be at the time empty, there is but little prospect of saving the patient. We often find these cases proving fatal even when every trace of the poison has been removed from the stomach, owing to the extensive changes produced and the sympathy with remote organs.

The following case of successful treatment which was reported by Mr. Gardner to the Lancet, Aug. 25, 1838, deserves to be here mentioned. A young man swallowed half an ounce of strong sulphuric acid. The usual symptoms appeared ; milk and carbonate of magnesia were freely given. This person recovered in twelve days. One of the secondary symptoms was profuse salivation. It is worthy of remark, that several cases of recovery have taken place, where no chemical antidotes were administered. The treatment consisted simply in the exhibition of large quantities of gruel and milk ; and there is no doubt, that any thick viscid liquid of this description, as, for example, linseed oil, must be beneficial, by combining with the acid and arresting its corrosive effects. In short, such a liquid would

act much in the same way as the presence of a large quantity of food is known to act, when the acid is swallowed soon after a meal. In all cases, however, it would be advisable to combine the use of chemical antidotes, with the administration of mucilaginous drinks.

CHEMICAL ANALYSIS.—This acid may be met with either concentrated or diluted; and a medical jurist may have to examine it under three conditions:—1. In its simple state.—2. When mixed with organic matters, as with liquid articles of food or in the contents of the stomach—3. On solid organic substances, as where the acid has been thrown or spilled on articles of dress or clothing.

In the simple state.—If *concentrated*, it possesses these properties:—1. A piece of wood or other organic matter plunged into it, is immediately carbonized or charred—2. When boiled with wood, copper cuttings or mercury, it evolves fumes of sulphurous acid; this is immediately known by the odour, as well as by the acid vapour first rendering blue and then bleaching starch-paper dipped in a solution of iodic acid.—3. When mixed with an equal bulk of water, great heat is given out.

TESTS.—For the acid in the *diluted* state, but one test need be applied:—a solution of a salt of barytes,—the nitrate of barytes, or the chloride of barium. Having ascertained by test paper, that the liquid is acid, we add to a portion of it, a few drops of nitric acid, and then a solution of nitrate of barytes. If sulphuric acid be present, a dense white precipitate of sulphate of barytes will fall down—which is insoluble in all acids and alkalies. If this precipitate be collected, dried and heated to redness in a small platina crucible with five or six parts of charcoal powder, it will, if a sulphate, be converted to the state of sulphuret. To determine this point, we add to the calcined residue, diluted muriatic acid, at the same time suspending over it, a slip of filtering paper moistened with a solution of acetate of lead, or what is exceedingly convenient, we place the residue on a slip of glazed card, (coated with carbonate of lead) scraped and wetted on the surface. (The card should be first tested; for some kinds of glazed cards are made without lead.) If the original precipitate were a sulphate, the vapour now evolved will be sulphuretted hydrogen, known by its odour, and by its turning the salt of lead to a brown colour. Instead of charcoal, we may use an equal bulk of cyanide of potassium as the reducing agent, and the experiment may then be performed in a small reduction tube over a spirit lamp. On breaking the tube and placing the powder on glazed card (containing lead) previously wetted, the stain of sulphuret of lead is perceived, or the calcined residue may be dissolved in water and tested. The smallest quantity of sulphate thus admits of easy detection.

The delicate action of this test is such that a solution containing not more than the 1-40,000th part by weight of sulphuric acid, is most readily precipitated by it. In the experiment, distilled water must be used, since all kinds of river and spring water are precipitated by the test. With regard to the reduction of the precipitate to the state of sulphuret by charcoal or cyanide of potassium, I have found that one-half grain of the sulphate of barytes will yield satisfactory evidence; and a quarter of a grain will give traces of sulphur, although somewhat indistinct. This is equivalent to about one-fifth of a grain of common oil of vitriol. In cases of poisoning, however, we either find the acid in much larger proportion, or it is altogether absent. Orfila recommends that the diluted acid should be concentrated by evaporation and then treated with metallic copper, to liberate sulphurous acid, but this process is more troublesome and less likely to prove satisfactory than that just described.

Objections to the tests.—When any inference is drawn by a medical witness from the presence of a minute quantity, it might be fairly objected that some portion of sulphuric acid may have become accidentally introduced during the experiment. Thus the nitric acid used may have been contaminated with sulphuric acid;—or the wood charcoal may itself have contained some

saline sulphates, which would lead to the production of an alkaline sulphuret. The purity of these substances should then be determined by separate experiments. Again, too much nitric acid must not be added to the liquid before applying the test:—because the salt of barytes is insoluble in strong nitric acid, and a white precipitate therefore falls, although no sulphuric acid be present. The obvious remedy for this, is to dilute the liquid with water before performing the experiment; or if a doubt exist, afterwards—when any precipitated sulphate of barytes will be left, while any portion of precipitated nitrate will be re-dissolved.

But the question arises—Are there no other liquids liable to be precipitated by this test and lead thereby to a fallacious inference? Nitrate of barytes is precipitated by other acids—namely, the sulphurous, fluosilicic, selenic and iodic. The last is not precipitated by the test if it be diluted, and the nitric acid be first added: therefore it can constitute no objection to the process here recommended. The three first form precipitates insoluble in nitric acid, exactly like the sulphuric acid. All objection on this ground is, however, removed by the fact, that sulphurous acid is immediately recognised by its odour of burning sulphur, and may be separated from any sulphuric acid mixed with it by simply boiling it:—and with respect to the fluosilicic and selenic acids the white precipitates formed by them, calcined with charcoal or cyanide of potassium do not evolve sulphuretted hydrogen, or act on a salt of lead like that formed by sulphuric acid. Besides, It is not probable that such substances as the fluosilicic, selenic and iodic acids should ever be met with in common life or find their way out of a chemical laboratory. The iodate, fluosilicate, and seleniate of barytes do not, like the sulphate, yield a sulphuret, when calcined with charcoal.

But there are other objections:—1. A solution of alum or any acid sulphate, might be erroneously pronounced to be free sulphuric acid; for alum would give all the re-actions with the tests here described. The answer to this objection is very simple; we must slowly evaporate a portion of the suspected liquid in a watch glass—there will be a saline residue if it be a solution of alum, otherwise not: for sulphuric acid should be entirely dissipated by heat, or should leave only the faintest traces of sulphate of lead. 2. The quantity of free sulphuric acid present, might be erroneously estimated, in consequence of some simple medicinal sulphate (as Epsom salt) being mixed with it. This may be determined also by evaporation; and the free sulphuric acid separated by warming the liquid, and adding finely-powdered carbonate of barytes, until effervescence ceases. The precipitate formed would be sulphate of barytes and represent the free sulphuric acid present.

There is, however, another source of error: any acid mixed with a common sulphate employed in medicine might be mistaken for free sulphuric acid;—as, for example, a mixture of citric or acetic acid with sulphate of magnesia. This may always be suspected when any saline residue is left on evaporating the mixture. In such a case carbonate of barytes would not separate the free acid, for it might form a soluble barytic salt with the extraneous acid, and this, by re-acting on the sulphate of magnesia, would precipitate the sulphuric acid of that salt, and thus lead to error. Several methods have been proposed to obviate this difficulty. The following is perhaps the best. Procure by evaporation and calcination, the whole of the saline sulphate from a measured quantity of the liquid. Re-dissolve this in water, acidulate the solution with nitric acid:—precipitate all the sulphuric acid of the salt by nitrate of barytes, then dry and weigh the sulphate thus procured. Next obtain from an equal quantity of the liquid before evaporation, the whole of the precipitate produced on adding to it the nitrate of barytes and nitric acid—dry it, weigh it, and compare its weight with that derived from the sulphate of the evaporated liquid. It is obvious, that if there be no free sulphuric acid present, the weights will be the same in the two cases:—but should there be any, its quantity will be indicated by the increased weight of the sulphate of barytes in the latter case. This may be regarded as an outline of the processes. There are some details omitted which will readily suggest themselves to the practical toxicologist.

In liquids containing organic matter.—If the sulphuric acid be mixed with such liquids as porter, coffee, or tea, the process for its detection is substantially the same, the liquid being rendered clear by filtration previously to adding the test. The sulphate of barytes, if mixed with organic matter, may be purified by boiling it in strong nitric acid; but this is not commonly necessary, as the reduction of the precipitate may be equally well performed with the impure, as with the pure sulphate. Some liquids generally contain sulphuric acid or a sulphate, such as vinegar and porter, but the acid is in very minute proportion; therefore, if there be an abundant precipitate, there can be no doubt, cæteris paribus, that free sulphuric acid has been added to them. Should the liquid be thick and viscid like gruel, it may be diluted with water, and then boiled with the addition of a little acetic acid. For the action of the test, it is not necessary that the liquid should be absolutely clear, provided it be not so thick as to interfere with the precipitation of the sulphate of barytes. So far with regard to articles administered, or of which the administration has been attempted.

Vomited matters.—These will commonly be found highly acid, reddening litmus paper, and causing effervescence with carbonated alkalies: they may be diluted with water, boiled, filtered and tested in the way above described. If the patient have been under treatment, these matters obtained from the stomach may have *no acid* reaction, either from the copious administration of water and abundant vomiting, or from an antidote having been used, such as magnesia. If on testing the neutral liquid, there be a precipitate, sulphuric acid can be present only in the state of sulphate;—if this precipitate be abundant, it cannot be due to the presence of minute traces of sulphates in the gastric and salivary secretions, but still it would be improper to infer from this chemical fact alone, that sulphuric acid has been swallowed, since it is well known that some saline sulphates, such as those of magnesia and soda, are often exhibited in large quantities medicinally; and it might be fairly objected to this evidence, that the precipitate was due to one of these salts. The symptoms, as well as other circumstances, would here aid the witness in forming an opinion—chemistry alone might mislead him.

In examining any organic liquid which has no acid reaction, it must be remembered that there are many salts in common use, some of them being medicines, which precipitate the barytic test. These are—all the soluble carbonates, phosphates, borates, tartrates and oxalates. It is to be observed, however, that not one of these substances is precipitated by the test, provided the liquid for analysis be diluted and acidulated with nitric acid before adding it. Should nitric acid produce any turbidness in an organic liquid, this may be again filtered and boiled before it is tested.

Contents of the Stomach.—When the patient survives, the analysis will of course be confined to the matters vomited. If the case prove fatal, we may be required to examine the contents of the stomach. Should these be acid and give a precipitate with the test, it may be said that the acidity was due to the acids naturally contained in the gastric secretions (the muriatic and acetic,) which, however, are in very small proportion, or to some acid liquid, taken as medicine or otherwise before death;—the precipitation by the test might also be ascribed to the presence of some medicinal sulphate. If the contents were not acid, then the effect produced by the test might be ascribed to the latter circumstance alone. All objections of this kind are at once removed not merely by resorting to the processes already described, but by noting particularly the presence or absence of the usual changes produced by mineral acids in the fauces, œsophagus, and stomach. The chemist might decide from an analysis alone; but the medical jurist must take into consideration the symptoms under which the deceased laboured, and the post-mortem appearances found in the body, before he ventures to pronounce an opinion from the results of his experiments.

Supposing the contents to give no evidence of the presence of the acid, we must then boil the changed or decomposed portions of the stomach in water, filter, and apply the tests to the filtered liquid. But still no evidence of the

presence of the poison may be obtained. Under these circumstances, it has been proposed by M. Devergie to heat the stomach to a high temperature in a retort, the beak of which is plunged into a mixture of iodic acid and starch. It is assumed that the non-discovery of poison is due to its combination with the substance of the stomach in a way so intimate, that water cannot separate it. The application of heat therefore would, in the process above mentioned, lead to a decomposition of the sulphuric acid by the carbon of the animal matter, and its transformation to sulphurous acid. This would be immediately indicated by the production of the blue iodide of farina. There are some objections which appear to me to render this process unfit for medico-legal purposes. Iodic acid is liable to be decomposed by many substances very different in their nature, as sulphuretted hydrogen gas, morphia, gallic acid, cyanide of potassium, sulphocyanate of potash and saliva, and it is not therefore safe to infer that the only deoxidizing agent in the distillation of the organic matter as above described, is the sulphurous acid, formed at the expense of the sulphuric acid, received *ab extra*, and combined with the tissues. Besides, the mucous membranes contain sulphur; and it is impossible to say that this may not be evolved and give rise to error. The reaction is so extremely sensitive, that the very smallest portion of sulphurous acid will decompose iodic acid. Hence it appears to me, that a medical jurist, when he finds no sulphuric acid in the stomach by the usual process of boiling, should rather declare that there is none present, than give an affirmative opinion of the existence of infinitesimal traces from the performance of a hazardous experiment.

It is a medico-legal fact of considerable importance, that the contents of the stomach in cases of poisoning by sulphuric acid, are often entirely free from any traces of the poison, even where it has been swallowed in large quantity. The acid is not commonly found when the individual has been under treatment, when there has been considerable vomiting, aided by the drinking of water or other simple liquids, or when the person has survived for a long period. If the case has been under treatment, the acid is either wholly absent or neutralized by antidotes. In support of this view, I might quote many reported cases; but I prefer giving two which I have witnessed. A girl swallowed four or five ounces of diluted vitriol, and died in eighteen hours. No portion of the acid could be detected in the stomach; but she had vomited considerably, and the acid was easily proved to exist in the vomited matters, by examining a portion of the sheet of a bed which had become wetted by them. In another case, nearly two ounces of the concentrated acid were swallowed; the patient died in twenty-five hours;—the stomach was most extensively acted on, and yet no trace of the acid could be discovered in the contents. The liquidity of the poison, and the facility with which it becomes mixed with other liquids, and ejected by vomiting, will readily furnish an explanation of this fact. In many cases of poisoning by sulphuric acid, therefore, a medical witness must be prepared to find, that chemical analysis will furnish only negative results. If the stomach should be perforated, the contents will be found in the abdomen or perhaps in the lower part of the cavity of the pelvis:—they may be absorbed by clean wetted linen or sponge, and these may be afterwards digested in distilled water, and the solution examined in the way described.

On solid organic substances.—It sometimes happens in cases of poisoning, that sulphuric acid is spilled upon articles of clothing, such as cloth or linen, and here a medical jurist may succeed in detecting it, when every other source of chemical evidence fails. Again, sulphuric acid is often used for the purpose of seriously injuring a party, as by throwing it on the person, an offence which, when accompanied with bodily injury, renders the offender liable to a severe punishment. On such occasions, proof of the nature of the corrosive liquid is required; and this is easily obtained by a chemical examination of part of the dress. The process of analysis is very simple. The piece of cloth should be digested in a small quantity of distilled water at a gentle heat,

whereby a brownish coloured liquid is commonly obtained on filtration. If sulphuric acid be present, the liquid will have a strong acid reaction, and produce the usual effects with the barytic test.

These spots on clothing, if produced by the concentrated acid, are known in general, 1. By the cloth, if coloured, having its colour changed to a dirty brown, acquiring a red border after a few days. Diluted sulphuric acid produces at once a red stain on black cloth. 2. By their remaining damp, or humid for a considerable period, the sulphuric being a very fixed acid, and absorbing water. That no objection may be offered to the result of an experiment of this kind, it is necessary that another part of the dress should be tested, in order to show that the sulphuric acid detected, is not due to the presence of any sulphate in the dress. Many articles of clothing, it must be remembered, yield slight traces of sulphates, when boiled in water. In the attempted erasure of writing from paper by diluted sulphuric acid, the same proofs will detect the presence of it. All white organic substances, such as calico or paper, although not blackened by diluted sulphuric acid, become, when impregnated with it, immediately charred on exposure to a moderate heat. The colour of black leather is not changed by sulphuric acid.

I have ascertained by experiment, that sulphuric acid may be easily detected on articles of clothing after many years' exposure. In January, 1831, a small quantity of this acid was spilled on a black cloth dress: it has been exposed in an open jar to the air for upwards of *fourteen years*. The cloth is changed to a deep brownish black colour; it is soft and yields to water a brownish coloured acid liquid, in which a large quantity of sulphuric acid is easily detected. In a case of poisoning, which occurred in 1832, the acid was partly spilled on a dress of printed cotton.—This has been likewise exposed for thirteen years, and the organic fibre is completely corroded by the acid, and reduced to a kind of humid powder. From this substance, by the addition of water, a liquid is obtained, the acidity of which is due to the presence of sulphuric acid. These facts are of some interest, because it has been generally supposed, that the stains on clothing soon lose all traces of the acid, partly by decomposition in contact with organic matter, and partly by evaporation; but it is hereby evident, that such stains, if not removed by washing, may be, in some instances, detected for a period of time much longer than is ever likely to be required in any medico-legal investigation.

In determining the presence of sulphuric acid in articles of clothing, I have found a modification of the iodic acid test extremely delicate and easy of application. The following is the way in which I have applied it: About half a grain of the article of dress, impregnated with sulphuric acid, was introduced into a short piece of glass tube, about one-eighth of an inch in diameter, and closed at one end. The stuff was then gently heated, and at the same time a piece of paper previously saturated with starch and moistened with a drop of iodic acid, was brought near the mouth of the tube. The blue iodide of farina was immediately produced by the sulphurous acid formed at the expense of the sulphuric acid, locked up in the organic substance. There could be no objection to this mode of employing the test, if we procured, at the same time, negative results from experimenting on other portions of the cloth unstained by sulphuric acid. If not more delicate than the barytic test, it has the advantage of being more readily applicable.

SULPHATE OF INDIGO.—Cases of accidental poisoning by this substance have occurred. As the compound is nothing more than a solution of indigo in common sulphuric acid, the symptoms and post-mortem appearances are the same as those that have been described for the latter substance. This kind of poisoning may be suspected, when, with these symptoms, the membrane of the mouth has a blue colour. The vomited matters are also of a deep blue tint; and in the case of a

girl, who swallowed an ounce and died eleven hours afterwards, it was remarked that the urine which she passed, had a tinge of blue. After death the mucous membrane of the lower part of the intestinal canal presented patches of a blue colour. In another instance, observed by Orfila,—a child which died in seven and a half hours, the urine was also tinged blue.

Chemical analysis.—The process is the same as that described for sulphuric acid in organic mixtures. The blue colour of the sulphate is immediately destroyed by boiling it with nitric acid. The barytic test may then be employed in the usual way.

Quantitative analysis of sulphuric acid.—It may be sometimes necessary to state how much sulphuric acid is present in a particular liquid. In order to determine this point, a portion of the liquid may be measured off, and the whole of the sulphuric acid present may be precipitated by the salt of barytes. The sulphate of barytes should be rendered pure by boiling it in nitric acid, then washed, dried and weighed. For every one hundred grains of dried sulphate obtained, we must allow about forty-one and a-half grains of common oil of vitriol to have been present; and so on in the same proportion for any other quantity. If we thus obtain the weight of the sulphuric acid present, it is very easy, from its known specific gravity, to calculate the quantity by measure.

CHAPTER X.

POISONING BY NITRIC ACID. (AQUA FORTIS.)

This substance is popularly known under the name of Aqua fortis, or red spirit of nitre. According to Tartra, it seems to have been first used as a poison about the middle of the fifteenth century. Although, it is perhaps, much more used in the arts than oil of vitriol, cases of poisoning by it, are by no means so common. Tartra was only able to collect fifty-six cases extending over a period of nearly four hundred years; and it appears from the return of inquisitions for 1837-8, there were only two instances reported to have occurred in England during those two years. Cases of poisoning by this acid have been chiefly the result of accident and suicide. I have only met with one instance where it was poured down the throat of a child for the purpose of murder. The external application of nitric acid has been a criminal cause of death on several occasions:—in one instance the acid was poured into the ear of a person while sleeping, and it led to the slow destruction of life. These are not strictly cases of poisoning, but more nearly approximate to death from wounding or mechanical violence. They will, therefore, be considered hereafter.

Symptoms.—These, on the whole, bear a close analogy to those produced by sulphuric acid. They come on *immediately*, and the swallowing of the acid is accompanied by the most intense burning pain in the fauces and œsophagus, extending downwards to the stomach:—there are

gaseous eructations from the chemical action of the poison,—swelling of the abdomen, violent vomiting of liquid or solid matters, mixed with altered blood and shreds of mucus, having a strong acid reaction. The abdomen is generally exquisitely tender; but in one well-marked case of poisoning by this acid, the pain was chiefly confined to the fauces. The mucous membrane of the mouth is commonly soft and white, after a time becoming yellow, or even brown; the teeth are also white, and the enamel is partially destroyed by the chemical action of the acid. There is great difficulty of speaking, as well as of deglutition; the power of swallowing is sometimes entirely lost. On opening the mouth, the tongue may be found swollen and of a citron colour, the tonsils are also swollen and enlarged. The difficulty of respiration is occasionally such, as to render tracheotomy indispensable, especially in young subjects. (Case by Mr. Arnott, Med. Gaz. xii. 220.) As the case proceeds, the pulse becomes small, frequent, and irregular; the surface of the body extremely cold, and there are frequent rigors. The administration of remedies—even the deglutition of the smallest quantity of liquid increases the severity of the pain, and gives rise to a feeling of laceration or corrosion. (Tartra, 144.) There is obstinate constipation. Death takes place in from eighteen to twenty-four hours, and is sometimes preceded by a kind of stupor easily removed. The intellectual faculties commonly remain clear until the last. Death may be occasioned by this acid, in consequence of its effect on the larynx, as in the case of sulphuric acid. Should the patient survive the first effects of the poison, the mucous membrane of the fauces and œsophagus is discharged either in irregular masses or there may be a complete cylinder of the œsophageal lining. There is great irritability of the stomach, vomiting and destruction of the powers of digestion: the patient becomes slowly emaciated, and dies from starvation or from exhaustion.

Post-mortem appearances.—The best account of these will be found in the well-known work of Tartra, (Traité de l'Empoisonnement par l'Acide Nitrique,) published upwards of forty years ago.

Supposing death to have taken place rapidly, the following appearances will be met with. The skin of the mouth and lips will present various shades of colour from an orange yellow to a brown; it appears like the skin after a blister or burn, and is easily detached from the subjacent parts. Yellow spots produced by the spilling of the acid, may be found about the hands and neck. A yellow frothy liquid escapes from the nose and mouth, and the abdomen is often much distended.

The membrane lining the mouth is sometimes white, at others of a citron colour, the teeth are white, but present a yellowish colour about the coronæ. The pharynx and larynx are much inflamed; the latter sometimes œdematous. The lining membrane of the œsophagus is softened, and of a yellow or brown colour, easily detached, often in long folds. The trachea is more vascular and the lungs are congested. The most strongly marked changes are seen in the stomach. When

not perforated, this organ may be found distended with gas—its mucous membrane partially inflamed with patches of a yellow, brown, or green colour, or even black. This green colour is due to the action of the acid on the colouring matter of the bile; but it must be remembered that a morbid state of the bile itself often gives this appearance to the mucous membrane in many cases of death from natural disease. There is occasionally inflammation of the peritoneum, and the stomach is glued to the surrounding organs. Its coats are often so much softened, as to break down under the slightest pressure. The duodenum sometimes presents similar changes; but in some cases the small intestines have presented no other appearance than that of slight vascularity.

It might be supposed that the stomach would be in general perforated by this very corrosive substance; but that is far from being the case. Tartra only met with two instances, and in one of these, the individual survived twenty, and in the other thirty hours. In giving this poison to rabbits, I have not found the stomach perforated, although the acid had evidently reached that organ. In these experiments the non-perforation appeared to be due to the protective influence of the food with which the stomach was distended. In the few cases that are reported in English journals, it would appear that the stomach has not been perforated: the poison had been swallowed soon after a meal, and its parietes thus escaped the corrosive action of the acid.

In cases of chronic poisoning, i. e. where death takes place slowly, the appearances are of course very different, as the following case will show. A man, aged thirty-four, swallowed a wine-glassful of nitric acid, but the greater portion was immediately rejected by vomiting, An attack of acute gastritis followed, which was combated by the usual remedies. The man was discharged from the hospital into which he had been admitted in three weeks; but about a month afterwards, he was readmitted in consequence of his suffering severe pain throughout the œsophagus to the epigastrium, as well as from vomiting after taking food. The patient gradually sank, and died three months after he had taken the acid. On dissection the pylorus was found so diminished in size, that its diameter did not exceed a line or two, and the duodenum was equally contracted for about an inch and a-half from its commencement. The mucous membrane was softened and red in patches; and there were several cicatrices of ulcers. The subjacent tissues were in a scirrhous state. (See Med. Chir. Rev. vol. xxviii. 553.)

As a contrast to this, we may here state the appearances met with in a case of poisoning by nitric acid, which proved rapidly fatal. A man swallowed about two ounces of aqua fortis, and died speedily from its effects. On examining the body, the lips were found partly yellow and partly of a brownish red colour, dried up like parchment. Several yellow or parchment-coloured spots, were observed on the chin, as also on the cravat. The mucous membrane of the mouth was white and easily detached,—that of the tongue was dry and hard,—that of

the pharynx and œsophagus yellowish green in colour and of a leathery consistency. The stomach contained a dark coloured liquid, highly acid. It was externally mottled of a greenish blue and black colour. The mucous membrane throughout was softened, and in a gangrenous state. The same appearances were met with, although in a less degree, in the duodenum and upper part of the ileum. On analysis, the contents of the stomach yielded nitric acid. (Von Raimann Medicinisch. Jahrb. 20 B. 2 S., p. 221.)

Quantity required to destroy life.—The remarks made on this subject in speaking of sulphuric acid, apply here. Tartra states, that the quantity usually taken varies from one or two drachms to four ounces, never more than this; but in most of the cases which he reports, the quantity taken is not mentioned. Indeed, the obtaining of any information of this kind is purely accidental; and the determination of the exact quantity swallowed, must be therefore very difficult. One point is certain;—the same quantity will not kill two individuals in the same time,—one may die slowly, and the other rapidly, according to whether the stomach should happen at the time to contain food or not. The *smallest* quantity which I find reported to have destroyed life, is about *two drachms*. It was in the case of a boy, aged thirteen: he died in about thirty-six hours. But less than this, even one drachm, would doubtless suffice to kill a child; and under certain circumstances, an adult; for the fatal result depends on the extent of the mischief produced by this corrosive poison in the larynx, œsophagus and stomach. What is the largest dose from the effects of which a person has recovered, it is difficult to say; since in the cases of recovery mentioned by authors, the quantity of the poison taken, was unknown.

Period at which death takes place.—This must depend on the quantity swallowed, the strength of the acid, and whether or not any remedial treatment may have been adopted. Out of twenty-seven deaths from nitric acid, reported by Tartra, in nineteen it destroyed life rapidly, and in eight slowly. This author met with two instances in which death took place within *six* hours after the poison was swallowed; but he considers that the greater number who fall victims to the direct effects of the poison, die within twenty-four hours. Sobernheim relates a case of poisoning by nitric acid, which proved fatal in *one hour and three quarters*. (Op. cit. 402.) This I believe to be the most rapidly fatal case on record, where the acid acted as a poison. The usual well-marked effects were found in the œsophagus, stomach and duodenum. In young infants, however, life may be destroyed by this poison in a few minutes, should it happen to affect the larynx. A woman shortly after her delivery, in the absence of her attendants, poured a quantity of nitric acid into the mouth of her young infant. The mother concealed from those about her this attempt at murder; but medical assistance was immediately sent for. The child died in a *few minutes*. Some of the acid had been spilled; and from the yellow colour of the stains, the medical man suspected

that the child had been poisoned by aqua fortis. On inspection, nitric acid was found in its stomach, and the mother confessed the crime. (Cazauvieilh Du Suicide et de l' Aliénation Mentale, p. 274.) Although in this case no mention is made of the state of the fauces and larynx, it is highly probable, from the rapidity with which death took place, that this event was in great part due to suffocation. The following experiment will perhaps serve to show how speedily life may be destroyed under these circumstances. Half a drachm of concentrated nitric acid was given to a rabbit. In about half a minute, it became insensible, and apparently lifeless. There was no sign of pain or irritation. It died in *one minute*. A small quantity of gaseous matter, in the form of a fuming vapour, escaped from the nostrils. The abdomen became much swollen. On inspection, it was found that the poison had strongly acted on and corroded the parts about the larynx. A portion had penetrated into the lungs, turning them yellow, and corroding them. Another portion had been swallowed, and had entered the stomach, producing the usual yellow stains, but it had not perforated the organ. With regard to the longest period at which death has taken place from the effects of this poison, a case has been already related, where a man who had swallowed nearly two ounces, did not die until three months afterwards. The longest case is perhaps that recorded by Tartra, where a woman perished from exhaustion, produced by the secondary effects of the poison, *eight months* after having swallowed it.

Treatment.—It may be the same as that recommended in poisoning by sulphuric acid. In addition to the remedies there suggested, a diluted solution of carbonate of soda with barley-water, and other demulcents, may be administered. In many cases, there is an utter impossibility of swallowing even the smallest quantities of liquid: and if an attempt be made to introduce these remedies by a tube, there is great risk of perforating the softened parietes of the pharynx, larynx, or œsophagus. Should suffocation be threatened, then tracheotomy may be resorted to. Modern experience is rather against the recovery of these cases, under any form of treatment:—but according to Tartra, in accidental poisoning by this acid, there is very great hope of recovery, if the case be timely attended to. He states that out of thirty-one such cases, twenty-three recovered, seventeen perfectly; while out of twenty-four cases, wherein suicide was attempted, only six recovered. (Op. cit. p. 186.)

Chemical analysis.—*In the simple state.* This acid may be met with either concentrated or diluted. The *concentrated acid* varies in colour from a deep orange red to a light straw yellow. It may be recognised,—1. By evolving acid fumes when exposed.—2. By its staining organic matter yellow or brown, the colour being heightened and turned of a reddish tint by contact with caustic alkalies.—3. When mixed with a few copper cuttings, it is rapidly decomposed—a deep red acid vapour is given off, and a greenish coloured solution of nitrate of copper is formed. Tin or mercury may be substituted for copper in this experiment.

Tests.—In the *diluted* state. This acid is not precipitated like the sul-

phuric by any common reagent, since all its alkaline combinations are soluble in water.—1. The liquid has a highly acid reaction, and on boiling it with some copper turnings, red fumes of nitrous acid vapour are given off, unless the proportion of water be very great. At the same time, the liquid acquires a blue colour.—2. A streak made on white paper with the diluted acid, does not carbonize it when heated; but a scarcely visible yellow stain is left.—3. The liquid is neither precipitated by nitrate of barytes nor by nitrate of silver. These two last experiments give merely negative results—they serve to show that the sulphuric and muriatic acids are absent.—4. By dipping a piece of bibulous paper in a weak solution of potash, and then in a portion of the acid liquid and drying it—it will be found, on drying and igniting it, if the acid be the nitric, that the paper burns with deflagration. This is not a property peculiar to nitric acid; but it distinguishes it from any of the common acids used as poisons. The chlorates, bromates, iodates, permanganates and bichromates, burn with deflagration in contact with organic matter. I have also observed this with respect to one metallic oxalate—the oxalate of silver.

In order to detect nitric acid, the liquid should be carefully neutralized by potash. This then should be evaporated slowly to obtain crystals. If the liquid be nitric acid, these crystals will possess the following characters.—1. They appear in the form of lengthened fluted prisms, which neither effloresce nor deliquesce on exposure. One drop of the solution evaporated spontaneously on glass will suffice to yield distinct and well-formed crystals. This character distinguishes the *nitrate* of potash from a very large number of salts.—2. When reduced to powder and heated with their bulk of finely-powdered charcoal on platina-foil, the mass suddenly ignites and burns with the well-known phenomena of deflagration. There are other salts that possess this property when heated with charcoal (suprà).—3. When moistened with strong sulphuric acid, the powdered crystals slowly evolve a colourless acid vapour. By this test, the nitrate is known from every other deflagrating salt.—4. A portion of the powdered crystals should be placed in a small tube and mixed with their bulk of fine copper filings. The mass is then to be moistened with water, and a few drops of strong sulphuric acid added. Either with or without the application of a gentle heat, a decomposition immediately ensues, by which red fumes of nitrous acid are evolved, recognisable by their colour, odour and acid reaction. This test answers equally well with a nearly saturated solution of the salt in water.

This last test is conclusive, and renders it unnecessary to resort to any other experiment. It is so delicate that, by using a tube only one-eighth of an inch in the bore, one-tenth of a grain of nitrate of potash will give satisfactory results. This is equivalent to about one-twentieth of a grain of nitric acid—a quantity to which the toxicologist will not often have to confine his analysis in medico-legal practice. I have found it advisable in these cases to adopt the following plan. Wrap the minute portion of nitrate in a small piece of the finest copper gauze, and drop the pellet thus formed to the bottom of the small tube. One drop of water followed by a drop of strong sulphuric acid, will by the aid of heat, suffice to evolve the red fumes of nitrous acid. Many other tests have been proposed for the detection of nitric acid as a nitrate.—1. The boiling of the suspected liquid with a small quantity of sulphate of indigo, when if nitric acid or a nitrate be present, the colour is discharged, but the same result takes place with iodic acid.—2. The boiling of the suspected nitric acid or solution of nitrate, with a few drops of muriatic acid and gold leaf, when the gold will become dissolved, a fact made evident, if not by the entire disappearance of the metal, by adding to the liquid a solution of protochloride of tin. A mixture of muriatic acid with the iodic will also dissolve gold.—3. Add to the liquid, a crystal of green sulphate of iron; if nitric acid be present, a dark green liquid is formed around the crystal as it dissolves:—if the solution be suspected to contain a nitrate, a few drops of sulphuric acid must be added, when the same effects will follow. If the quantity of nitric acid or a nitrate, be exceedingly small (i. e. 1-5000th,) the colour is pink, (Schweitzer.) This test distinguishes nitric acid or a nitrate from the salts of iodine and bromine.—Chemical Gazette, lvi. 85. The gas

produced by the action of sulphuric acid on a nitrate when mixed with copper, may be conducted by a tube into a solution of green sulphate of iron. — 4. Add to the suspected salt in powder, a few grains of morphia and some strong sulphuric acid: — if it be a nitrate, the saline mass acquires an orange or a yellow-brown colour from the action of the evolved nitric acid on the morphia (O'Shaughnessy). This last test appears to me to be objectionable:—much of the morphia, in common use, acquires a slight brown colour from contact with sulphuric acid only; and the results are certainly not so uniform or satisfactory as those obtained by the action of sulphuric acid and copper filings.—5. Orfila has lately proposed the sulphate of narcotine as a test for nitric acid or a nitrate (i. 137.) If strong sulphuric acid be poured on narcotine, the latter acquires a gamboge yellow colour, which when the twentieth part of a grain or less of nitric acid or a nitrate is added, is changed to a deep blood red, becoming more intense after a time. According to the same authority the sulphate of brucia is even more sensitive, the alkaloid acquiring a blood-red colour under the same circumstances, but I do not find the result to be so satisfactory. The sulphuric acid should in either case be added to the alkaloid first, since it might itself contain nitric acid as an impurity, and thus lead to error. The deutoxide of nitrogen also reddens sulphate of narcotine. A drop placed on glass or porcelain would give a reaction. The sulphate of narcotine is an exceedingly delicate test. Neither the iodic nor the chloric acid produces the same effect.

Objections.—I know of no objections which can be urged to the mode of testing for nitric acid above recommended. The test of deflagration is merely one of a series of characters, and cannot of itself furnish evidence of the presence of a nitrate. It may be regarded simply as a trial-test. With respect to the action of copper filings and sulphuric acid, there is no salt of potash but the nitrate (that which is compounded of nitric acid) which gives such results as have been described. The bromide of potassium gives off ruddy vapours, (bromine,) somewhat resembling those of nitrous acid; but these bleach litmus paper; and are in other respects easily distinguishable. Besides, these ruddy vapours are given off from the solid bromide by sulphuric acid without the addition of copper filings, whereas a nitrate under similar circumstances yields a colourless acid vapour. It may be safely affirmed, that bromine could not be mistaken for nitrous acid vapour, by one who has been at all accustomed to chemical analysis.

In liquids containing organic matter.—Nitric acid may be administered in such liquids as vinegar or porter. In this case, besides the acid reaction, there will be the peculiar smell produced by the acid, when mixed with substances of an organic nature. The application of the usual tests is here counteracted:—thus unless the quantity of nitric acid in such a liquid as porter be very considerable, the orange red fumes of nitrous acid are not evolved on boiling that liquid with copper-cuttings. If the liquid be viscid, this viscidity must be destroyed by dilution with water:—and in all cases, if any solid or insoluble substances are floating in it, as in the *matters vomited* or *contents of the stomach,* it must be filtered, in order to obtain at least a portion of the acid liquid. This operation is commonly very slow. If we procure the clear acid liquid, the colour may be disregarded. We should then carefully neutralize it with a weak solution of potash, or its carbonate; and boil it with a large quantity of well-washed animal charcoal for two hours. On filtration, it will probably come through of a pale yellow colour. If the colour should be at all deep, it must be reboiled with a fresh quantity of animal charcoal, and now on filtration it will be tolerably clear. Concentrate to a small bulk by evaporation. As a trial-test we may dip in a slip of bibulous paper, dry it, and observe whether it burns with deflagration. This commonly answers, unless the quantity of nitric acid present be very small, or unless the nitrate of potash formed, be mixed with a large portion of some other salt. A few drops of the liquid may then be crystallized on a piece of glass, by slow evaporation; and the resulting crystals examined for all those properties which have been described as characteristic of the compound of potash with nitric acid. The crystals obtained, may be coloured

and impure. This circumstance does not at all interfere with the action of the most important test for nitric acid, namely, that by copper-filings and sulphuric acid. They may, however, if necessary, be purified by digesting them in pure ether, or pure alcohol. These liquids do not dissolve the nitrate of potash; but will often serve to remove from it the organic matters by which it is coloured. This process, according to my observation, is very effectual in detecting nitric acid, when mixed with liquids resembling porter. If the acid has been administered in vinegar, acetate of potash is formed during the neutralization, as well as nitrate. The acetate may be separated by pure alcohol, in which it is very soluble, while the nitrate remains undissolved. Other modifications will suggest themselves, according to the nature of the liquid, with which the acid is mixed.

But the vomited matters and contents of the stomach may have no acid reaction, and yet nitric acid be present. Thus it may have become neutralized by lime or magnesia, through the administration of antidotes. In such a case, it would not be easily detected, unless it were in pretty large quantity. By the addition of carbonate of potash to the filtered neutral liquid, these earthy nitrates may be transformed to nitre, and the analysis then proceeded with,—the carbonates of lime and magnesia formed, being separated by filtration. Again, for the same reasons as those mentioned in speaking of sulphuric acid, the liquid found in the stomach of a person who has died from nitric acid, may not contain a trace of the poison, either free or combined. Its absence, therefore, does not negative a charge of poisoning. Nitric acid has a much stronger tendency than the sulphuric to combine with the solid organic tissues; and in decomposing them, it undergoes decomposition itself. In a case of this kind, those parts of the mucous membrane, whether of the œsophagus or stomach, which are stained yellow or corroded, should be boiled in water, rendered alkaline by potash. The resulting liquid may then be examined for nitre. This experiment, from the small quantity of free acid present, is very likely to fail. In examining the stomachs of rabbits killed by nitric acid, I have found that even deeply stained portions of mucous membrane have yielded commonly only very faint traces of acid. But the discovery of no more than traces of acid in these cases of poisoning, is, in my opinion, tantamount to a failure of the chemical branch of evidence; for no inference could be drawn from such minute results relative to the fact of poisoning, unless the evidence from symptoms and post-mortem appearances, with moral circumstances, were sufficiently conclusive; and when this is the case, whether the poison be wholly absent, or exist only in infinitesimal traces, must be a matter of trifling importance. It may perhaps be proper to mention in this place, that the nitrates have not been found to exist as natural constituents of the secretions of the alimentary canal. If any alkaline chloride be present in the organic liquid, it will be difficult to obtain evidence of nitric acid or a nitrate by the usual tests, since a decomposition would ensue whereby chlorine would be evolved. In order to counteract this difficulty, Dr. Christison has recommended the entire precipitation of the chloride in the first instance, by a hot solution of acetate of silver. Oxide of silver would answer the same purpose. Orfila states that he has discovered nitric acid in the urine of animals poisoned by it. He considers that it had been absorbed and carried into that liquid. (i. 145.)

On solid organic substances.—We have already spoken of the modification required in the analysis, in reference to the supposed presence of the poison in the discoloured or corroded portions of mucous membrane. This acid is, however, sometimes maliciously thrown at persons; and we may be required to examine some article of dress, suspected to have been stained by it. The spots produced by strong nitric acid on woollen stuffs, are either of a yellow, orange red, or a brown colour, according to the time at which they are seen. On black cloth they are at first of a light brown colour, passing after eight or ten days to an olive green with a red border. After a time, they become dry, (unlike those produced by strong sulphuric acid,) and the texture of the cloth is entirely destroyed. In order to examine them, the stained portions may be cut out and digested in a small quantity of warm distilled water. If

nitric acid be still present, the water will acquire an acid reaction ; but in order to establish this, the liquor must be neutralized by potash, then evaporated and examined for nitrate of potash in the way already described. Should the water acquire no acid reaction, then there is no perceptible quantity of acid present. To render this certain, however, the water may be made feebly alkaline by potash, and again boiled with the stuff; the liquid may be filtered and examined for nitre. It is rare, that any evidence of the presence of nitric acid is obtained by this latter process, when the stained portions of cloth do not give out any free acid to the distilled water in the first instance. Should any traces of nitric acid be perceived in an experiment of this kind, an unattacked portion of cloth or stuff must be examined, before we can draw the inference that nitric acid has been spilled or thrown on it. On these occasions we may be often disappointed in searching for chemical evidence of nitric acid. Not to mention that the acid may be easily removed by washing while the stain remains, we must remember that it is volatile, easily decomposed. and its nature is entirely changed by contact with organic matter. These facts will explain to us, why after a few weeks the chemical evidence of the presence of this acid will sometimes be entirely lost; while in the case of sulphuric acid, the stains may furnish abundant evidence of its presence after many years' exposure. In all cases of the suspected throwing of nitric acid, the spots on the dress should be examined as soon as possible, or the chemical analysis will fail. The following case occurred lately at Guy's hospital: A man had some strong nitric acid maliciously thrown in his face, and the sight of one eye was thereby entirely destroyed. He wore at the time a blue stuff coat, which was not sent to be examined until *five-weeks* after the accident, and only a few days before the trial of the prisoner for the offence. The sleeve and body of the coat were found to be covered with numerous spots of a yellowish brown colour. The spots were quite dry; they had evidently been caused by the action of some corrosive acid. The colour was discharged, and the fibre of the stuff corroded. Not a trace of nitric acid could be detected in them, although there was no doubt that it had been used. Its disappearance was probably due partly to its decomposition in the stuff, and partly to its volatility. Had the coat been examined soon after the offence, the nature of the acid would have been easily determined. I have been able to procure certain evidence of the presence of nitric acid in stains on black cloth, a fortnight after the liquid had been spilled. The quantity of acid present was so small, that on adding to the filtered liquid, gold leaf and muriatic acid, there was no apparent solution of the metal, nor on trying another portion with sulphate of indigo was the colour discharged. A third portion of the acid liquor was neutralized by carbonate of potash, and evaporated, when crystals of nitre (amounting to about a grain) were obtained. These rapidly gave, with copper filings and sulphuric acid, the characters of a nitrate. There was but a thin slip of cloth used in the experiment. Dr. Christison has obtained evidence of the presence of the acid in stains on cloth made seven weeks before. (178.) The neutralized liquid in such cases gives a well-marked effect with sulphate of narcotine.

In conducting an analysis of this kind, it has been recommended, when we obtain an acid liquid, to test it with the nitrate of barytes and nitrate of silver. The liquid, if it contain nitric acid only, should give negative results; but there are few specimens of cloths which do not yield traces of sulphuric and muriatic acids or of sulphates and muriates or chlorides, so that nitric acid may still be present when one or the other of these tests is affected.

QUANTITATIVE ANALYSIS.—Convert the nitric acid, contained in a measured quantity of the liquid, to nitre in the way above described. Convert the whole quantity of nitre thus obtained to sulphate of potash by the cautious addition of strong sulphuric acid. Dissolve this salt in water, and evaporate to dryness. Calcine the residue, and afterwards wash it with alcohol, to remove if necessary any portion of free sulphuric acid. For every one hundred grains of dry sulphate of potash thus obtained, we may estimate that there were present in the measured quantity of liquid, about eighty-two grains of liquid nitric acid, (aqua fortis)—the bulk of which, by measure, may be

easily determined by calculation. Should the dried sulphate be very acid, it may be necessary to moisten it with a solution of sesquicarbonate of ammonia, and re-expose it to heat, to drive off the volatile alkali with the surplus sulphuric acid. Sulphate of potash, it must be remembered, is a perfectly neutral salt.

CHAPTER XI.

POISONING BY MURIATIC ACID. (SPIRIT OF SALT.) AQUA REGIA AND NITRO-SULPHURIC ACID.

But very little is known concerning the action of muriatic or hydrochloric acid as a poison. That this form of poisoning is not very common, may be inferred from the fact, that Orfila has reported only one case, communicated to him by Dr. Serres, in his large work on Toxicology, (i. 155). In the Coroners' report for England, during the years 1837-8, out of five hundred and twenty-seven cases of poisoning, there was not one in which this acid was the poison used. I have been able to collect the reports of only *three* cases of poisoning by muriatic acid that have occurred in this metropolis, during a period of thirteen years. From this statement, it will be seen that the medico-legal history of this kind of poisoning must be very incomplete.

Symptoms.—From the few imperfect reports that have yet appeared, the symptoms produced by this acid do not differ widely from those caused by the two other mineral acids, described in the preceding chapters. There is the same sensation of burning heat extending from the throat to the epigastrium, with vomiting of a highly acid liquid of a dark green colour, mixed with mucus and altered blood. The tongue becomes swollen and dry; and with much thirst, there is great difficulty of deglutition. The tonsils and throat are inflamed. It is said, that there is an escape of acrid pungent vapours from the mouth, when the acid is first swallowed (Orfila); but this does not seem to have been observed in any of the reported English cases. In two instances, neither the vomiting nor pain in the abdomen was urgent, although both terminated fatally. The chief seat of pain was in the throat and fauces. In one instance, in which probably an ounce of the acid had been swallowed, the individual was able to walk to his home at a distance of three quarters of a mile. In general, the power of locomotion appears to be destroyed in mineral-acid-poisoning, from the extreme severity of the pain. The pulse has been observed to be small, frequent and irregular; the skin cold and clammy. The intellectual faculties have remained clear until death.

Post-mortem appearances.—The fauces, larynx, and œsophagus,

have been found highly inflamed, the mucous membrane lying in detached masses or actually sloughing away. In one instance, the membrane was thickened. The coats of the stomach have been so much corroded that, in many places, there was only the peritoneal tunic left; and in attempting to remove the organ in this case, the parietes gave way. The contents have been sometimes of a yellowish, at others of a dark green colour. In one case, where the fundus of the gall-bladder came in contact with the stomach, it was observed to have a bright green colour, arising from the well-known action of this acid on the bile. In no instance was the stomach perforated. On removing the contents, the lining membrane has been found of a black colour, presenting a charred appearance—the blackening extending through the whole length of the duodenum, and being especially marked on the prominent parts of the numerous valvulæ conniventes, the intervals being stained of a greenish-yellow colour from the action of the acid on the bile.—(Case by Mr. Quekett, Med. Gaz., Nov. 1839.) When death did not take place until after the lapse of several days, the coats of the stomach were highly inflamed, and for the most part in a sloughing state;—large dark shreds of membrane were hanging from the sides of the organ, especially about the pylorus. The inflammation had extended also into the duodenum.

Quantity required to destroy life.—With respect to this question and *the period* at which the case proves fatal, there is no reason to suppose that the muriatic acid differs from the sulphuric and nitric acids, in relation to these points. The cases that have hitherto occurred throw but little light upon these questions. The medical jurist must be content to draw an inference, the fairness of which cannot be disputed, when it is based upon the strong analogy which exists between the effects of this and the other two acids. The facts at present before us are these. In one case, two ounces destroyed life in thirty-three hours; in a second, the same quantity killed the person in eight days; and in a third, a like dose proved fatal *in five hours and a half*. This, I believe, is the most rapidly fatal case on record. The smallest dose that appears to have destroyed life was about an *ounce*. The patient died in fifteen hours. In the case reported by Orfila, the dose was an ounce and a half, and this proved fatal in about eighteen hours. If cases of poisoning by this substance were more frequent, it would, no doubt, be found that not only might death take place within a much shorter period, but that a much smaller quantity, even one drachm, might prove fatal. All the cases of poisoning by this acid, which I have found reported, have occurred in adults; some from accident, and others from suicide. There is no instance, so far as I know, in which this acid has ever been used for the purposes of murder.

Treatment.—The same as in poisoning by sulphuric and nitric acids.

Chemical Analysis.—The commercial acid has a deep lemon-yellow

colour. It contains iron, and often common salt, leaving a residue of impurity on evaporation. It is not commonly so *concentrated*, as to possess the property of fuming in the air; a property which of course depends on its strength, and therefore may be present or absent in any given specimen. The liquid will be found highly acid:—it tinges organic substances of a yellow colour, and corrodes them. 1. When boiled with copper, there is but little action, the acid is in great part distilled over in vapour. 2. The acid, if moderately pure, may be boiled entirely away on pure mercury without being affected by the metal. These tests eminently distinguish the muriatic from the two preceding acids. 3. When boiled with black oxide of manganese, in fine powder, chlorine is evolved, known by its colour, odour, and bleaching properties on litmus and other colouring matters. This last test is conclusive:—there is no other acid which is thus affected by the peroxide of manganese. One drop of muriatic acid in a tube of very small bore, will give satisfactory results.

Tests.—When the acid is much *diluted* with water, the property of evolving chlorine with peroxide of manganese, is lost. In this case, there is one most satisfactory test for the presence of muriatic acid—the nitrate of silver. This test gives, with the acid, a dense white clotted precipitate of chloride of silver. The precipitate thus formed, acquires speedily a dark colour by exposure to light, and it is known from all other white salts of silver, by the following properties. 1. It is insoluble in nitric acid. 2. It is very soluble in caustic ammonia. 3. It is insoluble in caustic potash. 4. When dried, and heated on platina or glass, it melts like a resin, forming a yellowish-coloured sectile mass. Unless these properties be possessed by the precipitate, it is impossible to refer the action of the test to the presence of muriatic acid. The delicacy of this test is such, that it will easily detect the one-hundredth part of a grain of muriatic acid diffused in a large quantity of water.

The diluted muriatic acid is also known from the diluted nitric and sulphuric acids, by boiling the liquid with a slip of bright copper and a few drops of a solution of arsenious acid. If muriatic acid be present, the copper acquires a grey coat of metallic arsenic,—with nitric and sulphuric acids, it retains its red lustre unchanged. In this way, also, muriatic acid may be discovered when mixed with dilute nitric, sulphuric, or other acids.

Objections.—It may be objected to the application of the silver test, that other acids form with it white precipitates, which might be mistaken for the chloride of silver. There are two common acids, both of them poisons, namely, the prussic and the oxalic, which, in this respect, resemble the muriatic. The prussic acid would be immediately known by its odour, or by the effect of heat on the cyanide of silver. The white precipitate produced by the test in oxalic acid, is known from the chloride by its entire solubility in nitric acid. The evaporation of a portion of the tested acid liquid, would moreover leave crystals of a solid acid. Iodic acid also gives a dense white precipitate with nitrate of silver, and the iodate of silver thus formed, resembles the chloride in being insoluble in nitric acid, and soluble in caustic ammonia. The iodic acid is a body which is rarely met with out of a chemical laboratory. It is immediately known from the muriatic acid, by adding to the liquid, sulphurous acid and starch, when blue iodide of farina is produced. The iodate of silver differs from the chloride, in not being so readily changed by exposure to light: and in being decomposed by caustic potash, which separates from it, brown oxide of silver. The oxalate of silver is also thus known from the chloride: oxide of silver being separated from it. The chloride is unchanged by caustic potash until heat is applied:—oxide of silver is then slowly produced. Caustic potash may therefore serve to distinguish these precipitates of the salts of silver from each other.

Again, the mixture of any simple acid, such as the acetic, tartaric, or citric, with a solution of common salt, might be pronounced to be muriatic acid from the action of the test; when in reality, no free muriatic acid was present. A suspicion of this kind would naturally arise, if on evaporating a portion of the acid liquid, a large quantity of a solid white residue was obtained. The difficulty in such a case may be removed by resorting to the pro-

cess recommended in speaking of sulphuric acid (antè, p. 76.) If we take equal portions of the acid liquid, and precipitate one portion entirely by nitrate of silver,—then evaporate the other portion to dryness, dissolve the dry salt in water, and precipitate this solution entirely by the test, it is obvious that if there be no free muriatic acid present, the precipitated chloride will have exactly the same weight in the two cases. The precipitate should in each case be well washed in water, acidulated with nitric acid. If free muriatic acid were present, the precipitate obtained in the former case would exceed in weight that obtained in the latter.

In liquids containing organic matter.—Such liquids will have a highly acid reaction. It might be supposed that the nitrate of silver would serve as a good trial test, but it must be remembered, that this salt is liable to be precipitated by numerous organic liquids, such as vinegar and porter, although no free muriatic acid be present. This arises either from the presence of chlorides in most liquids of this description, or from oxide of silver being itself precipitated by certain organic principles. In the last-mentioned case, the precipitate is known from the chloride by being entirely soluble in nitric acid. This test for muriatic acid cannot however be safely employed in the analysis of any liquid containing organic matter. Under these circumstances there are two ways of proceeding. 1. To distil the liquid at a low temperature in a retort fitted with a receiver. Any free muriatic acid will pass over, be condensed, and may now be safely tested. As a trial-test, we may put a drop of solution of nitrate of silver on a slip of glass, and expose it to the vapour of the liquid submitted to distillation. If muriatic acid be present, a white precipitate will be formed insoluble in nitric acid. This experiment does not absolutely prove the presence of free muriatic acid. Exactly the same results would be obtained if prussic acid were mixed with the organic liquid. The odour would, however, enable the operator to judge which acid was present. Again, a mixture of sulphuric acid with a muriate in the liquid, would produce the same effect and lead to error. The action of nitrate of barytes upon the acid organic liquid, would, however, show whether or not sulphuric acid were present. This process only answers when the muriatic acid is in moderately large proportion. If the quantity be small, none is obtained unless the distillation is carried to dryness, but then the process is open to objection. (See Ann. D'Hyg., Oct. 1842, 339.) 2. We may evaporate to dryness, a fractional portion of the organic liquid; calcine any residue, and observe whether on digestion in water and filtration, we obtain a solution of a chloride; if not, we must neutralize the acid organic liquid by adding carbonate of soda—then evaporate and incinerate the residue. In this way, we obtain all the muriatic acid contained in the liquid as chloride of sodium. Should any chloride result from the first evaporation of the acid liquid,—the quantity of muriatic acid thus obtained, must be deducted from that which results in the last-mentioned process.

Vomited matters and contents of the stomach.—The process is the same in the two cases. The liquid should be separated from the solid portions by filtration through cotton or paper. If acid, we must proceed as directed in speaking of the analysis of an organic liquid. In giving evidence on this point, a witness may be fairly asked, whether the natural secretions of the stomach do not owe their acidity to the presence of free muriatic acid. The experiments of Dr. Prout have proved that this is really the case:—that the gastric secretions are acid, owing to the presence of free muriatic and acetic acids. An objection of this kind is answered by the facts,—that the quantity of free muriatic acid, naturally contained in the gastric secretions, does not exceed the 1500th part by weight, i. e.—five grains in sixteen ounces of liquid,—(Prout.) This would give only a very feeble acidity, and but a trivial result with the test; whereas, the liquid may be intensely acid, and yield a large quantity of muriatic acid on being distilled. 2. The medical jurist would look for the characteristic symptoms and post-mortem appearances, before he inferred that the mineral acid had been taken as a poison. If these are wanting, and the quantity of free muriatic acid is but small, then there would be no evidence of poisoning, so far as chemical analysis was concerned.

A mixture of vinegar and salt might be easily mistaken for muriatic acid in an organic liquid, but no muriatic acid would be obtained on distillation, and no additional quantity of chloride would be obtained on neutralization by carbonate of soda and incineration. As organic matter holds muriatic acid with strong affinity, Orfila has recommended that it should be precipitated by a strong solution of tannic acid, before distillation is resorted to. The liquid for examination may be neutral, owing to the administration of antidotes. The muriatic acid may have been neutralized by carbonate of soda or magnesia. This would be discovered on evaporation, and the quantity of resulting alkaline chloride would indicate the quantity of muriatic acid. But to any inference of this kind, there are very strong objections. If the quantity of chloride of sodium be *small*, the results might be referred to the portion of that salt which always exists naturally in the gastric secretions ; if *large*, the chloride of sodium is so common an ingredient in most kinds of food, that its presence in the contents of the stomach might cæteris paribus be fairly ascribed to this source. On the whole, then, it is clear that the chemical evidence in poisoning by muriatic acid must fail, unless the acid be discovered in large quantity and in a free state, in the contents of the stomach ; and unless there be at the same time, corroborative evidence of poisoning from symptoms and post-mortem appearances. It need hardly be observed, that owing to violent vomiting or medical treatment, all traces of the acid may have disappeared from the stomach, notwithstanding the person may have died from its effects. It does not appear that muriatic acid was found in the stomach in the few cases of poisoning by it, which are on record.

On solid organic substances.—Chemical evidence may be obtained from this source, when other sources fail. In Mr. Quekett's case, no muriatic acid was found in the stomach: but the nature of the poison was accurately determined by examining a piece of the deceased's waistcoat, on which some of the acid swallowed, had become accidentally spilled. By digesting the stuff in warm distilled water, a highly acid liquid may be obtained on filtration, which, if muriatic acid be present, will yield, with nitrate of silver, a white precipitate, possessing all the properties of chloride of silver. The spots produced on black cloth by strong acid are at first of a bright red, but in ten or twelve days they change to a red brown. Hence it will be perceived that this acid differs from the others in the effect produced on black cloth. Sulphuric and nitric acids produce brown and not red stains, the stain from the former acquiring a red fringe only after some days. An unstained portion of the cloth should always be examined by way of comparison. I have remarked that the red colour produced by muriatic acid in black cloth is removed by boiling water, the cloth becoming black, but again on drying acquiring a red brown colour. The diluted muriatic, like the diluted sulphuric and nitric acids, produces at once red stains on black cloth. If muriatic acid be used for the erasure of writing-ink, its presence in the paper may be detected by a similar process.

For the analysis of CHLORIDE OF SODIUM see post.

QUANTITATIVE ANALYSIS.—This may be performed by estimating the quantity of muriatic acid from the quantity of chloride of silver obtained from the whole, or a fractional part of the liquid subjected to analysis. For every 100 grains of the thoroughly dried chloride of silver, we may allow sixty-nine grains of muriatic acid of the ordinary Pharmacopœial strength.

In general the mineral acids are taken separately as poisons ; but it may happen that they will be taken in a mixed state; more especially as some mixtures of this description are largely used in the arts. Thus, the AQUA REGIA, a mixture of nitric and muriatic acids, is used for dissolving gold and platina ; while the AQUA REGINÆ nitro-sulphuric acid, is employed for dissolving silver and separating it from plated articles. I have not been able to find in any work on toxicology, an

account of a case of poisoning by the nitro-muriatic acid; but Orfila gives one instance of poisoning by nitro-sulphuric acid.

A man aged twenty-four, swallowed a mixture consisting of one ounce of strong nitric acid and two drachms of strong sulphuric acid. The usual symptoms followed, and he died in eight hours. The post-mortem appearances, as might have been presumed from the relative quantities of the two acids taken, were more those of nitric than of sulphuric acid. (Toxicologie Générale, i. 109, 3éme ed.)

There is but little doubt that nitro-muriatic acid would produce symptoms, and cause appearances, analogous to those described in speaking of muriatic acid. The mixed effects of nitric acid might be also perceptible. The quantity required to destroy life, and the period at which death will ensue, may be inferred from what has been already said of those acids.

Chemical Analysis.—*Nitro-muriatic acid.*—This liquid is of a deep yellow or red colour, and is intensely acid.—1. It is known from its two component acids, by immediately dissolving leaf-gold, either with or without the aid of a gentle heat.—2. On boiling a portion of the mixture, chlorine gas is evolved; and litmus paper is bleached at the mouth of the vessel.—3. Muriatic acid is detected by boiling in it some cuttings of copper—the red fumes of nitrous acid are evolved. Unless there be sulphuric acid present, nitrate of barytes will give no precipitate with the diluted acid. It is difficult to understand, that it would ever be necessary for legal purposes to determine the relative proportions of nitric and muriatic acids in this compound. If such a necessity arose, oxide of silver might be used to separate the muriatic acid, and the quantity of this deducted from the whole quantity of acid experimented on, would give the proportion of nitric acid. There are other methods of a purely chemical nature for which chemical works may be consulted.

Nitro-sulphuric acid —This acid may be easily mistaken for sulphuric acid, since it gives a white precipitate with a salt of barytes, and the nitric acid remains concealed.

Process.—Add carbonate of barytes in fine powder to the mixed acids, largely diluted, until they are neutralized. The sulphuric acid alone is precipitated, as sulphate of barytes. This may be separated by filtration, washed with water acidulated with nitric acid, dried and weighed, by which the quantity of sulphuric acid will be determined. The filtered liquid, on being evaporated, will yield crystals of nitrate of barytes, in which the presence of nitric acid may be easily determined by the usual tests. In the arts, it is common to employ a mixture of sulphuric acid and nitrate of potash, instead of nitric acid. In this case, the carbonate of barytes would precipitate the sulphuric acid, and leave the nitrate unaffected, so that the analysis is rendered more easy. Both the nitro-muriatic and nitro-sulphuric acids discharge the colour of sulphate of indigo at a boiling temperature.

CHAPTER XII.

POISONING BY THE OXALIC, TARTARIC, AND ACETIC ACIDS.

Oxalic acid is one of the most powerful of the common poisons, although its use as such is almost entirely confined to this country. Cases of poisoning by it, are generally the result of suicide or accident.

In the Coroner's return for 1837-8, there were nineteen cases of poisoning by this substance, out of which number, fourteen were the result of suicide. It is singular, also, that the greater number of these, occurred in the county of Middlesex. Accidental poisoning by oxalic acid has arisen from its strong resemblance to Epsom salts. It is not often that we hear of its being used as a poison for the purposes of murder. Its intensely acid taste, which could not be concealed by admixture with any common article of food, would infallibly lead to detection, long before a fatal dose has been swallowed. I have known several trials to take place for attempted poisoning by oxalic acid,—in two the vehicle, selected for its administration, was coffee or tea, and in one, which occurred recently, the poison was powdered and mixed up with brown sugar to conceal the taste. (*Reg.* v. *Dickman*, Central Criminal Court, February, 1845.)

Symptoms.—In many cases of poisoning by this substance, death has taken place so rapidly, that the individual has not been seen alive by a medical practitioner. If the poison is taken in a large dose, i. e. from half an ounce to an ounce of the crystals dissolved in water, a hot burning acid taste is experienced in the act of swallowing, and vomiting occurs either immediately, or within a few minutes. Should the poison be diluted, there is merely a sensation of strong acidity, and vomiting only occurs after a quarter of an hour or twenty minutes. In some instances, there has been very little or no vomiting; while in others, this symptom has been incessant until death. The vomited matters are highly acid, and have a greenish brown, or almost black colour; they consist chiefly of mucus and altered blood. There is at the same time great pain and tenderness in the epigastrium, followed by cold clammy perspiration and convulsions. In a case which occurred at Guy's Hospital, in May 1842, where about two ounces of the poison had been swallowed, there was no pain. Urgent vomiting and collapse were the chief symptoms. There is entire prostration of strength, so that the individual falls, if he be in the erect position; there is likewise unconsciousness of surrounding objects, and a kind of stupor, from which, however, the patient may be without difficulty, roused. From the severity of the pain, the legs are sometimes drawn up towards the abdomen. The pulse is small, irregular and scarcely perceptible; there is a sensation of numbness in the extremities, and respiration, shortly before death, becomes spasmodic. The inspirations are deep, and a long interval elapses between them. Such are the symptoms commonly observed in a rapidly fatal case.

Should the patient survive the first effects of the poison, the following symptoms appear: There is soreness of the mouth,—constriction in the throat, with painful deglutition,—tenderness in the abdomen, with irritability of the stomach, so that there is frequent vomiting, accompanied by diarrhœa. The tongue becomes swollen, and there is great thirst. The patient may slowly recover from these symptoms. In a case related by Mr. Edwards to the Westminster Medical Society, the patient, a female, lost her voice for eight days; but whether this

depended on the action of the oxalic acid which she had taken, or not, it is difficult to say. Certain it is, that this poison has a remote effect on the nervous system, indicated by the numbness and tingling in the extremities, which have been observed to remain, long after the person has recovered from the first effects.

POST-MORTEM APPEARANCES.—The lining membrane of the mouth, fauces and œsophagus, is commonly white, although it is often coated with a portion of the dark brown mucous matter discharged from the stomach. This latter organ contains a dark brown mucous liquid, often acid, and having almost a gelatinous consistency. On removing the contents, the mucous membrane will be seen pale and softened, without presenting any marks of inflammation or abrasion, if death have taken place rapidly. This membrane is soft and brittle, easily raised by the scalpel, and presents much the appearance, which we might suppose it to assume, after having been for some time boiled in water. The small vessels are seen ramifying over the surface, filled with dark-coloured blood, apparently solidified within them. The lining membrane of the œsophagus presents much the same characters. It is pale, and appears as if it had been boiled in water, or digested in alcohol; it has been found strongly raised in longitudinal rugæ, interrupted by patches where the membrane has become abraded. With respect to the intestines, the upper portion of the canal may be found inflamed; but unless the case be protracted, the appearances in these viscera, are not very strongly marked. In a recent case of poisoning by this acid, where two ounces had been taken, and death was rapid, the coats of the stomach presented almost the carbonized appearance produced by sulphuric acid.

Oxalic acid does not appear to have a corrosive action on the stomach like the mineral acids. It is rare to hear of the coats of the organ being perforated by it. In many experiments on animals, and in some few observations on the human subject, I have found nothing to bear out the view that perforation is a common effect of the action of this poison. It renders the mucous coat soft and brittle. Dr. Christison refers to only one instance, in which the stomach was found perforated. Orfila does not report one instance. A case of alleged perforation of the stomach by oxalic acid has, however, been reported in the Medical Gazette, xxxv. p. 49.

In protracted cases, the œsophagus, stomach and intestines have been found more or less inflamed. In some instances, there have been scarcely any perceptible morbid appearances produced.

QUANTITY REQUIRED TO DESTROY LIFE.—A trial for murder by this poison took place in 1832, in which this question was put judicially to the medical witnesses. One deposed, that he thought ten grains of the acid was sufficient to destroy life, another that it was not sufficient. The prisoner was acquitted. A question of this kind can only be solved by a reference to recorded facts; but unfortunately, in most cases, it has been impossible to determine exactly the quantity of poison taken.

Oxalic acid, it is to be observed, presents some singular anomalies in its effects. In one case, a man swallowed, as nearly as could be ascertained, three drachms of the crystals:—there was immediate vomiting, but no other urgent symptoms, and he recovered in a few hours. In a second instance, a woman took nearly half an ounce of oxalic acid—the usual symptoms appeared—she recovered in six days, and was able to leave the hospital. Mr. Semple met with a case, where a girl swallowed about *two drachms* of the poison dissolved in water. Vomiting occurred immediately. In about twelve hours, the more urgent symptoms had disappeared; but there was still tenderness of the epigastrium with irritability of the stomach. In the course of a few days, the patient was quite well. In February, 1842, a case occurred at King's College Hospital, where a girl had swallowed *two drachms* of the acid, dissolved in beer. The only symptom from which she suffered on admission, was pain. She entirely recovered the next day. Dr. Babington, of Coleraine, reports a case (Med. Gaz. xxvii. 870,) in which a girl swallowed by mistake two scruples *(forty grains)* of the poison. Severe symptoms followed, chiefly marked by great gastric irritation. It was a week before this girl was convalescent, and a much longer time elapsed, before she was able to resume her duties. In all of these cases, it is to be observed, active medical treatment was resorted to; and the effects of the poison may be therefore supposed to have been in a great degree counteracted. This will also explain, why some have recovered, who have taken even half an ounce or more of the poison, while others have died where the dose has not exceeded that quantity. A smaller dose than *half an ounce* of the crystals, has not, so far as I am aware, been known to prove fatal; although from the serious effects which have followed doses less than this, it is probable that a smaller quantity might destroy life where medical treatment was not resorted to. Two cases have occurred at Guy's Hospital, where in each, half an ounce of oxalic acid had been swallowed. Active treatment was adopted, and both patients recovered. When the dose is upwards of half an ounce, death is commonly the result; but one of my pupils lately informed me of a case where a man recovered, after having taken one ounce of the crystallized oxalic acid. This poison is retailed to the public at the rate of from a quarter to half an ounce for twopence, and one ounce for fourpence or sixpence.

Period at which death takes place.—It is proper to observe, that the same quantity of the poison does not always destroy life within the same period of time. In two cases, where about two ounces of the acid were taken, one man died in twenty minutes,—the other in three quarters of an hour. Dr. Christison mentions a case, where an ounce killed a girl in thirty minutes; and another where the same quantity destroyed life in *ten minutes*. This last is perhaps the most rapidly fatal case on record. When the dose is half an ounce and upwards, death commonly takes place in an hour. There are, it must be admitted, numerous exceptions to this rapidity of action. Dr.

Christison reports two cases, which did not prove fatal for thirteen hours; and in an instance, that occurred to Mr. Fraser, in which only half an ounce was taken, the individual died from the secondary effects in a state of perfect exhaustion, twenty-three days after taking the poison.

Treatment.—It is recommended that water should be sparingly given, as it is apt to lead to the more extensive diffusion and absorption of the poison. But in some instances water has been found to be productive of great benefit; and has aided the efforts of the stomach to expel the poison by vomiting. The proper antidotes are chalk, compound chalk powder, magnesia or its carbonate, made into a cream with water and freely exhibited. These remedies appear, from the cases reported, to have been very efficacious when timely administered. A case in which this treatment was successful will be found reported by Mr. Tapson, (Med. Gaz. xxxi. 491.) The woman is said to have swallowed two ounces, but this is obviously a mistake. I agree with Dr. Christison in thinking that it is more likely to have been two drachms. A mixture of lime water and oil might be advantageously employed. If much fluid has been swallowed, then the stomach pump may be resorted to. The poison in many instances acts with such rapidity, as to render the application of these remedies, a hopeless measure. The exhibition of the alkalies,—potash, soda or their carbonates, must in all cases be avoided: since the salts which they form with oxalic acid, are as poisonous as the acid itself.

Chemical analysis.—*In the simple state.*—This acid may be met with, either as a solid, or in solution in water. *Solid oxalic acid.* It is seen more or less perfectly crystallized in four-sided prisms, in which respect it differs from all other acids, mineral and vegetable. The crystals are unchangeable in air. They are soluble in water and even in anhydrous alcohol. The solubility in water is variously stated. I have found some specimens much more soluble than others; and the conclusion from the experiments which I have made is, that the acid is soluble in from twelve to fourteen times its weight of water. If there be any adhering nitric acid about the crystals, they are much more soluble.

The crystals of oxalic acid are liable to be mistaken for those of two other salts, namely, the sulphate of magnesia (Epsom salts), and sulphate of zinc (white vitriol). The chemical differences are, however, well marked. Oxalic acid, when heated on platina foil, is entirely volatilized, or only a very slight residue of impurity is left, while the sulphates of magnesia and zinc are fixed. If the three substances be dissolved in water, it will be found that, while the solution of oxalic acid is intensely acid,—that of the sulphate of magnesia is neutral,—and of the sulphate of zinc, very feebly acid. If a solution of caustic potash be added to the diluted solutions of the three bodies in water, those of magnesia and zinc yield white flocculent precipitates, that of oxalic acid remains unchanged. The most simple method of distinguishing them is by the taste. Oxalic acid is immediately indicated by the intense acidity of its solution.

For the further analysis of the acid, the crystals must be dissolved in distilled water: but should a suspected *solution* of the poison in water, be presented for examination, it will be proper, after testing it with litmus paper, to evaporate a few drops on a slip of glass, in order to observe whether crystals be obtained. If there should be none, there can be no oxalic acid present. If fine and distinct prisms be procured, then it will be proper to proceed with the analysis of the solution.

Tests.—1. *Nitrate of silver.* When added to a solution of oxalic acid, it produces an abundant white precipitate of oxalate of silver. A solution containing only the 4000th part by weight of oxalic acid, is affected by this test; but where the quantity of poison is small, it would be always advisable to concentrate the liquid before applying it. The oxalate of silver is identified by the following properties: 1. It is completely dissolved by cold nitric acid, by which it is known from the chloride, iodate and cyanide. 2. When collected on a filter, thoroughly dried and heated on thin platina foil, it is entirely dissipated in a white vapour with a slight detonation. When in very small quantities, this detonation may be observed in detached particles on burning the filter previously well dried. 2. *Sulphate of lime.* A solution of oxalic acid is precipitated white by lime water and all the salts of lime Lime water is itself objectonable as a test, because it is precipitated white by many other acids, as the carbonic, tartaric, phosphoric and arsenious. The salt of lime, which, as a test, is open to the least objection, is the sulphate. As this is not a very soluble salt, its solution must be added in rather large quantity, to the suspected poisonons liquid. A fine white precipitate of oxalate of lime is slowly formed. This precipitate should possess the following properties:—1. It ought to be immediately soluble in nitric acid. 2. It ought not to be dissolved by the tartaric or any vegetable acid. Unless these precipitates be obtained, and their properties, as above described, determined, it cannot be said that oxalic acid is present in the solution.

Objections to the tests.—A liquid may be highly acid, yield crystals of oxalic acid on evaporation, and yet neither of the above-mentioned tests will act. This may happen when nitric acid is present in rather large proportion. As a matter of precaution in a doubtful case, the whole of the solution should be evaporated to crystallization, and the crystals dried and re-dissolved in water, before performing the experiments. It may be urged that the nitrate of silver precipitates other acids. Thus it forms white precipitates with the muriatic, prussic and iodic acids, but these precipitates are insoluble in cold nitric acid and do not detonate when dried and heated. The test gives only a slight turbidness with the tartaric and citric acids when highly concentrated, instead of the abundant milk-white precipitate which is produced in a solution of oxalic acid, even when considerably diluted. Besides, there is no common acid but the oxalic, which is precipated by sulphate of lime. The paratartaric or racemic acid is precipitated by this test, but the acid is so rarely met with as scarcely to form an exception. Paratartrate of silver does not detonate like the oxalate. One objection to this last-mentioned test, is that it precipitates acid as well as neutral solutions of the salts of baryta and strontia; and an acid solution of muriate of strontia might somewhat resemble in this respect a solution of oxalic acid; but not to mention that there are numerous ways by which this kind of difficulty may be easily removed,—the sulphates of barytes and strontia are eminently distinguished from oxalate of lime by their rapid precipitation and by their perfect insolubility in nitric acid.

It has been recommended to neutralize the oxalic acid by ammonia, or potash, before applying the tests. The tests then certainly precipitate the oxalic acid more rapidly and abundantly. The objections, however, to the results become more numerous; and although these are easily susceptible of being removed in the hands of a practised toxicologist, it must be confessed that just doubts might often be entertained of the accuracy of the inference drawn from them by others. If the poison be already neutralized, as under the form of oxalate of ammonia, we have no alternative but to apply them. But we must remember that, while the two tests above mentioned, nitrate of silver and sulphate of lime, are precipitated by very few *acids*, they are precipitated by numerous *salts*; and the precipitates possess properties, which it is sometimes difficult to distinguish from those of the oxalates of lime and silver. Thus the alkaline tartrates, citrates, carbonates, phosphates, pyrophosphates, borates when concentrated, and iodates, are precipitated by one or both of the tests, like the oxalates; and if muriate of lime be used

instead of the sulphate of lime, the alkaline sulphates would also be precipitated. It may be observed, however, that the recently precipitated tartrate and citrate of silver are distinguished from the oxalate, 1, by their being decomposed on boiling while the oxalate of silver retains its whiteness, and is not decomposed at a boiling heat, but is readily dissolved, forming a clear solution if oxalic acid be in excess. 2. The dried tartrate, heated on platina, burns without detonation: it becomes incandescent, and leaves a solid residue of metallic silver in a white fungous mass. The dried citrate partially decrepitates, and leaves a grey fibrous residue of metallic silver. Thus, then, these salts differ from the oxalate, which is entirely dissipated by detonation. Again, sulphate of lime does not precipitate an alkaline tartrate or a citrate, unless the salts be highly concentrated, while an oxalate is precipitated by the test even in the most diluted state. If, therefore, any doubt exist respecting the nature of the salt, it should be diluted with water before adding the test. The dried precipitates also differ. The oxalate of lime is silently converted, when heated on platina, to carbonate of lime or caustic lime, according to the temperature. The tartrate and citrate undergo partial combustion, leaving a grey or carbonaceous residue.

Other tests have been proposed, as, for instance, the sulphate of copper, and solution of strontia, but they add no force to the evidence afforded by those above-mentioned, and we may conclude that when we obtain from an acid solution, a solid acid substance crystallizing in well-defined prisms—these crystals remaining unchanged in air, being volatilizable without combustion, and giving, when dissolved in water, on addition of the nitrate of silver and sulphate of lime, the results above described, there can be no doubt that the substance is oxalic acid. Additional tests may or may not be employed, but any evidence, short of this, should not, it appears to me, be admitted, to show the presence of the poison.

In liquids containing organic matter.—The process is the same, whether it apply to liquids in which the poison is administered, or to the *matters vomited*, or lastly, to the *contents of the stomach*. This poison is not liable to be decomposed or precipitated by organic principles; and, therefore, it is commonly found in solution in the liquid portion, which will then have a greater or less acid reaction. Should the liquid be very acid, we must filter it to separate any insoluble matters; should it not be very acid, the whole may be boiled, if necessary, with distilled water, before filtration is performed. A small quantity of the liquid may now be tested by solution of *Sulphate of copper*. This serves as a trial test; for oxalic acid is the only acid precipitated by it. If a greenish white precipitate is formed either immediately or in a few minutes, oxalic acid may be present; but if none be formed, then either there is no oxalic acid present, or it is in very small quantity. On no account are the tests for oxalic acid to be employed in liquids containing organic matter, since nitrate of silver is easily precipitated by such matters, although none of the poison be present. It must be remembered in using the sulphate of copper as a trial test, that it will not precipitate oxalic acid if this be mixed with a strong mineral acid. Should the liquid be highly coloured, it may first be boiled for some time with well-washed animal charcoal. After this it may be filtered and concentrated by evaporation. To the filtered liquid, acetate of lead should be added until there is no further precipitation; and the white precipitate formed, collected and washed. If any oxalic acid were present in the liquid, it will exist in this precipitate under the form of oxalate of lead. There are two methods of separating oxalic acid from the oxalate of lead.

1. Diffuse the precipitate in water, and pass into the liquid for about two hours, a current of sulphuretted hydrogen gas, taking care that the gas comes in contact with every portion of the precipitate. Black sulphuret of lead will be precipitated; and with it commonly the greater part of the organic matter, which may have been mixed with the oxalate of lead. Filter to separate the sulphuret of lead; the filtered liquid may be clear and highly acid. Concentrate by evaporation; the sulphuretted

hydrogen dissolved in the liquid is thereby expelled, and oxalic acid may be ultimately obtained crystallized by evaporation on a piece of plate glass. If there were no oxalic acid present in the precipitate, no crystals will be procured on evaporation. If crystals be obtained, then they must be dissolved in water and tested in the way above directed. As a modification of this test, and to shorten the process, I have lately adopted the plan of digesting the precipitate in hydrosulphuret of ammonia, taking care not to use too much of this compound. Oxalate of ammonia is obtained in the filtered liquid.

2. The second process consists in boiling the precipitated oxalate of lead in water, containing a small quantity of sulphuric acid (the proportion regulated by the quantity of precipitate) for half an hour. Sulphate of lead is formed and oxalic acid is set free; this becomes mixed with any surplus sulphuric acid. Filter and neutralize cautiously by ammonia; the liquid often becomes turbid from the precipitation of a small quantity of oxalate of lead suspended by sulphuric acid. Allow this to subside, and then test it with the nitrate of silver and sulphate of lime. The characters of oxalic acid, if it be present, are immediately brought out; the sulphate of ammonia, here formed with the oxalate, does not in the least interfere with the application of the tests. I have used both of these processes in cases of poisoning, and have succeeded in detecting a small quantity of oxalic acid by them, in the contents of the stomach. In both cases there had been violent vomiting,—one proved fatal in twenty minutes, the other in three quarters of an hour. Of the two processes, the first is the best adapted for obtainiug crystallized oxalic adid; the second is the more expeditious for obtaining chemical evidence of the presence of the poison.

Objections.—If, in the course of this analysis, acetate of lead should give no precipitate with the liquid even when neutralized,—then oxalic acid is not present in a quantity sufficient to be detected. If it should give a precipitate, still there may be no oxalic acid present. The medical jurist must remember, that the acetate of lead is precipitated by most kinds of organic matter, and by many mineral and vegetable acids and their salts. Thus, if he be operating on the contents of the stomach, the presence of Epsom salt, (sulphate of magnesia,) any alkaline sulphate, common salt, (chloride of sodium,) --any tartrate, citrate, phosphate, or carbonate, would occasion a white precipitate with the acetate of lead. The presence of the sulphuric, muriatic, tartaric, citric, acetic, gallic, or tannic acid, either free or mixed with any of the above-mentioned salts, would produce the same result. A mixture of vinegar and salt or of lemon juice and Epsom salts would give an acid reaction and be precipitated by acetate of lead like the oxalic acid. Common London porter is acid, and is precipitated by all the salts of lead. The answer to any objection of this kind, is, that the analyst does not decide on the presence of oxalic acid from the effect of acetate of lead on the suspected liquid; but from the action of the proper tests for the poison on the acid substance separated by sulphuretted hydrogen from the precipitate, formed by the acetate. This latter is not a test, but merely a means of separation to enable us to apply the other tests with safety. The nitrate of lead may be substituted for the acetate. It has this advantage, that unlike the acetate it gives no precipitate with the tartaric, citric, or gallic acid. Orfila condemns the plan here recommended for the separation of oxalic acid, because the same results would be obtained if binoxalate of potash or salt of sorrel were present in the organic liquid. Sorrel is much used in soup in France, but not, so far as I know, in England, hence the objection is one of a national character. In order to remove the supposed difficulty, Orfila proposes that the evaporated organic liquid should, be repeatedly digested wlth pure alcohol at common temperatures :—this, according to him, will dissolve the oxalic acid but not the binoxalate, and thus the two may be separated, (i. 190.) It would be indeed unfortunate for medical jurists if they were obliged to rely upon this process. Alcohol, as pure as it can commonly be procured, will certainly acquire an acid reaction when digested on

binoxalate of potash. Hence, by relying on Orfila's process, the analyist would be deceived, and would pronounce oxalic acid, as such, to be present, when the deceased might only have partaken of the supposed sorrel soup. In order to meet this objection, it appears to me that we should inquire whether it is likely that the deceased had eaten of sorrel? what were his symptoms before death? whether be died suddenly after partaking of some liquid or solid?—whether there were any peculiar post-mortem appearances in the fauces, œsophagus, or stomach?—whether the quantity of oxalic acid found in the stomach, would not be utterly incompatible with the hypothesis that it was due to the presence of salt of sorrel taken at a meal? A case of criminal poisoning by oxalic acid, is not likely to occur where an answer to one or more of these questions would not be obtained.

It is difficult to state the exact length of the period after death, at which we might expect to discover this poison in the contents of the stomach. Having on one occasion detected it in the contents of the stomach of a person who had been poisoned, I placed the liquid aside for about *five* weeks during the summer. On re-examining it at the end of this period, it had become highly putrefied. ammonia had formed, and not a trace of the poison could be detected. Nevertheless, except when in very small quantity, and under exposure to extreme putrefaction, oxalic acid does not seem to be liable to disappear in contact with animal and vegetable substances. On the 19th January, 1835, *forty grains* of oxalic acid were added to six ounces of a mixture composed of gruel, porter, and albumen. The liquid has been kept in a bottle loosely corked: and although upwards of *ten years* have elapsed, the liquid is still acid, and oxalic acid may be readily detected in it.

The stomach after death may contain no traces of the poison. This will happen where the case is protracted,—vomiting has been urgent or the stomach-pump employed. On the other hand, the poison may be present, but in an insoluble form, where lime or magnesia has been given as an antidote. White chalky masses may in this case be found adhering to the mucous surface of the stomach, or subsiding as a sediment in the liquid contents. The analysis for oxalate of lime will answer for the oxalate of magnesia.

Oxalate of Lime.—The suspected oxalate of lime should be boiled for about twenty minutes, with an equal weight of carbonate of potash, in distilled water. A partial double decomposition takes place:—the undissolved residue containing some carbonate of lime, and the liquid some oxalate of potash. The liquid may be filtered, neutralized by nitric acid, and then tested with the tests already described for a soluble oxalate. If there be any desire to determine the nature of the alkali with which the oxalic acid is combined, some of the sediment obtained from the liquids, or scraped from the surface of the stomach, may be calcined on platina foil, when caustic lime or magnesia will be left, easily known from each other by their respective chemical characters.

The discovery of oxalate of lime in the stomach, is said to be no proof of oxalic acid having been taken as a poison, because rhubarb powder contains that salt. Admitting this latter statement to be correct, of which I have some doubt, having examined two different specimens of rhubarb powder without discovering any trace of oxalic acid, either combined with lime or any other base; it is difficult to comprehend how this can form any objection to the inference from a medico-legal analysis of the contents of the stomach. Oxalate of lime is never found in the stomach in a case of poisoning by oxalic acid, unless an antidote of lime has been given. But if an antidote has been used, there will be evidence from symptoms, and in this case the discovery of any portion of oxalic acid in the stomach after death, may perhaps not be at all material:—the fact of poisoning would be sufficiently apparent from other circumstances. To give this objection any sort of force, it is necessary to suppose that a person, after having swallowed an enormous dose of rhubarb, is by a mere coincidence seized with symptoms resembling those of poisoning by oxalic acid, and dies:—chalk mixture having been exhi-

bited before death:—further, that on inspection, no appearances indicative of the action of oxalic acid, are found in the fauces, œsophagus, or stomach; and lastly, that the presence of oxalate of lime in the stomach, is of itself chemical evidence that the person has died from taking oxalic acid! Such a hypothetical case appears to me to carry with it its own refutation, in the facts which must necessarily accompany it.

Oxalic acid is supposed to enter the blood, and give it a dark brown colour. In a case which proved rapidly fatal, where two ounces of the poison had been taken, I examined four ounces of blood taken from the vena cava: but not a trace of oxalic acid could be detected. Dr. Christison states that he did not succeed in detecting the poison in the blood when it had been purposely injected into the femoral vein of an animal which died in thirty seconds. These negative results may be explained by supposing that the poison is decomposed, or the means of separating it from organic compounds are not sufficiently delicate. In two cases, leeches have been killed by the blood drawn by them, from persons who were at the time labouring under the effects of this poison. This seems to render it probable that the blood is poisoned, and, indeed, Orfila states that he has succeeded in detecting it in the urine although not in the solid organs, (i. 190.) When solid organic matters, such as cloth, paper, or linen, are impregnated with oxalic acid, proofs of this may be obtained, by digesting the spots in water and applying the usual tests. Oxalic acid does not corrode these substances like a mineral acid, but it very slowly produces orange yellow spots with a red margin on black cloth, in which respect it differs from the other vegetable acids. This acid is sometimes used for erasing writing-ink in cases of forgery.

Quantitative analysis.—The quantity of oxalic acid present in a measured portion of any mixture, may be best estimated by precipitating it entirely as oxalate of lead. For every hundred grains of the dried precipitate we may allow forty-two grains of crystallized oxalic acid. In some instances, it may be more convenient to precipitate it as oxalate of lime by means of muriate of lime; the quantity of oxalic acid may then be estimated from the equivalent of that oxalate.

Binoxalate of potash.—Salt of sorrel.—It will be necessary to speak of this salt, in this place, since its poisonous effects entirely depend on the oxalic acid which it contains. It is said to be much used for the purpose of bleaching straw and removing ink-stains—being sold under the name of essential salt of lemons. Its poisonous properties are not commonly known, or no doubt it would be frequently substituted for oxalic acid. Three cases of poisoning by this substance have occurred within the last two years, two of which proved fatal, while in the other, the patient recovered.

In the case of recovery a young lady, aged twenty, swallowed an ounce of the salt dissolved in warm water. She was not seen by any one for an hour and a half: she was then found on the floor, faint and exhausted, having previously vomited considerably. There was great depression, the skin cold and clammy, the pulse feeble, and there was a scalding sensation in the throat and stomach. There were also continued rigors. Proper medical treatment was adopted, and she recovered in two days,—still suffering from debility and great irritation of the stomach. During the state of depression, it was remarked that the conjunctivæ were much injected, and the pupils dilated. There was also great dimness of vision. (Med. Gaz. xxvii. 480.)

In another of the cases,—a lady recently confined took by mistake

half an ounce of the binoxalate instead of cream of tartar. She had scarcely swallowed the draught, when she was seized with violent pain in the abdomen and convulsions: she died in *eight minutes*. On inspection, the mucous membrane of the stomach and small intestines was found inflamed. (Ann. D'Hyg. Avril, 1842.) In the third case, a teaspoonful of this salt was taken for three successive mornings:—it produced severe vomiting; and about an hour after the third dose, the patient expired. There was no post-mortem examination.

We learn from these cases, that this salt is poisonous, destroying life almost as readily as oxalic acid itself; and that in the symptoms which it produces, it closely resembles that poison. In the second case, it destroyed life even more rapidly than oxalic acid has ever been known to do, i. e. in *eight minutes;* but probably the fatal effects were there accelerated by the debilitated state of the person who took it.

Chemical analysis.—The *solid* salt is commonly seen in the form of a crystalline powder, or loosely crystallized in masses. It is not very soluble in water, easily taken up on boiling, but re-precipitated in great part, on cooling. Its solution might be readily mistaken for oxalic acid; for, 1, it has an acid reaction; and, 2nd, it is precipitated by nitrate of silver and sulphate of lime, like oxalic acid; but with respect to the latter test, the precipitation, although more slowly formed, is much more copious. It is best known from oxalic acid, 1, by its crystalline form, which, as seen in a few drops evaporated on glass, is plumose, and 2, by heating a portion on platina foil. While oxalic acid is volatile, the binoxalate leaves an ash, which, when sufficiently calcined, is alkaline, and it may be proved to contain potash by its dissolving in dilute nitric acid, with effervescence and forming nitrate of potash. There is one vegetable salt for which it has been fatally mistaken, namely, the bitartrate of potash, or cream of tartar. This latter is known by its solution not being precipitated by sulphate or muriate of lime; and by its being rendered only milky or turbid on the addition of nitrate of silver. Lime water furnishes a ready means of distinguishing these two salts. It precipitates both of them white, but the precipitate from the bitartrate of potash is redissolved on adding to it a small quantity of a solution of tartaric acid, while that from the binoxalate is not re-dissolved. It may be as well to mention another simple means of distinction, the colour of ink is immediately discharged by warming it with a few grains of binoxalate, but is unaffected by the bitartrate of potash.

In organic mixtures the process is the same as for oxalic acid itself.

Tartaric acid.—Since the publication of the first edition of this work, a case has occurred in which tartaric acid has destroyed life, although it had been generally regarded as not poisonous. The case here referred to was the subject of a trial for manslaughter at the Central Criminal Court, January, 1845. The accused gave the deceased, a man aged twenty-four, by mistake, one ounce of tartaric acid instead of aperient salts. The deceased swallowed the whole dissolved in half a pint of warm water at a dose; he immediately exclaimed that he was poisoned: he complained of having a burning sensation in his throat and stomach, as though he had drunk oil of vitriol, and that he could compare it to nothing but being all on fire. Soda and magnesia were administered with diluent drinks. Vomiting set in and

continued until his death, which took place nine days afterwards. On inspection nearly the whole of the alimentary canal was found highly inflamed. The accused admitted that he had made the mistake, and tartaric acid was found in the dregs of the cup. The jury acquitted the prisoner. (*Reg.* v. *Watkins.*)

TREATMENT.—The same as in poisoning by oxalic acid.

CHEMICAL ANALYSIS.—Tartaric acid is known by the following characters. 1, When heated on platina foil it burns with a pale reddish coloured flame evolving a peculiar odour and leaving an abundant residue of carbon. 2. It forms an acid solution in water, which when moderately concentrated yields a granular precipitate with a few drops of caustic potash, (Bitartrate). 3. It is precipitated white by lime water; when the latter is added in large quantity the precipitate being immediately dissolved by an excess of the acid. 4. It gives no precipitate, or only a slight opacity with nitrate of silver, (thus known from oxalic acid). 5. When exactly neutralized by potash and nitrate of silver is added, a white precipitate is formed which is immediately blackened and reduced to the state of metallic silver on heating the liquid to 212°.

BITARTRATE OF POTASH. (CREAM OF TARTAR. ARGOL.)—This salt has proved fatal in at least one instance, although it is not commonly regarded as a poison. The case is reported by Mr. Tyson; it occurred in this metropolis in 1837. A man, aged thirty-seven, took four or five table-spoonfuls of cream of tartar. He was seized with violent vomiting and purging. There was pain in the abdomen; thirst, feeble pulse, and the thighs and legs appeared paralysed. The fluid vomited was of a dark green colour, and the motions, of the colour of coffee-grounds. Death took place in about forty-eight hours. On inspection, the mucous membrane of the stomach and duodenum was found highly inflamed, the cardiac portion of the former being of a deep red colour with some spots of black extravasation. The stomach contained a thick brown fluid, coloured by bile. The whole of the intestinal canal was more or less inflamed.

CHEMICAL ANALYSIS.—Cream of tartar is commonly seen in the form of a white powder. It is sparingly soluble in cold water, producing a slightly acid solution. If the powder be heated on platina foil, it is converted to carbon and carbonate of potash; the latter dissolves with effervescence in acids, and the nature of the alkali is thereby determined. The decomposition of the powder by heat, indicates that it is a vegetable acid salt. On adding the aqueous solution to lime water, a white precipitate is formed, which disappears on adding a further quantity of the solution. This proves that the acid is the tartaric. It is known from the simple tartrate of potash by its acidity, and the fact that it is not precipitated by the muriate of lime, while the tartrate is precipitated as tartrate of lime. Chloride of platina gives no precipitate in the cold saturated solution.

In *organic mixtures.*—The salt being comparatively insoluble, may be found as a sediment at the bottom of the liquid. If dissolved, the liquid may be concentrated and alcohol added; cream of tartar is very insoluble in alcohol, and by this means the organic matter may be separated from it. If the liquid were only coloured, animal charcoal should be used to decolorize it. Belloc relates a case of supposed poisoning by Rochelle salt the compound tartrate of potash and soda. The circumstances however render this statement somewhat doubtful. (Cours de Med. Lég. 139.)

Citric acid may also act as an irritant poison in large doses, but in the common state of lemon juice, which contains only from one to two per cent, it must be regarded as inert. I am not aware that there is any case on record in which citric acid has acted injuriously in the human subject.

Acetic acid.—This acid has been generally excluded from the class of poisons. Common vinegar, which contains only five per cent of acetic acid, has often been taken in large doses without injurious consequences.

From the experiments performed by Orfila on dogs, and from one case which he reports as having occurred in the human subject, acetic acid, when concentrated, appears to exert an irritant action on the body. (Annales D'Hygiéne, 1831, ii. 159, also Toxicologie, ii. 198.) This is not more than we might have expected, seeing that the concentrated acid is highly corrosive.

In the case referred to, the deceased, a young female aged nineteen, was found dying on the highway. She suffered from convulsions and complained of pain in the stomach, and died in a very short time. On inspection, the stomach was found neither softened nor corroded, but its mucous membrane near the pylorus was almost black. The mucous glands were prominent, and the vessels were filled with a black coagulated blood.

Treatment.—Magnesia or its carbonates mixed into a cream with water.

Chemical analysis.—1. Acetic acid is known by its peculiar odour which, if not perceptible in the cold, may be evolved on boiling the liquid. 2. It is entirely volatile, and leaves no solid residue on evaporation. 3. It is not precipitated by the acetate of lead, in which it differs from other vegetable and some mineral acids. 4. It is not precipitated by lime water or any salt of lime, whereby it is known from the oxalic, tartaric and other vegetable acids. 5. When diluted it is not precipitated by nitrate of silver or nitrate of barytes, and is thus known from the muriatic and sulphuric acids. 6. When neutralized by potash it forms a salt highly soluble in alcohol and water, which yields acetic acid when boiled with diluted sulphuric acid.

In organic mixtures.—Acetic acid may be obtained by distillation with or without the addition of sulphuric acid from these suspected liquids; but if operating on the contents of the stomach, it must be remembered that acetic acid is a natural constituent, although in small proportion of the gastric juice, that it may also be formed by acetous fomentation, and that in the shape of vinegar, it is a very common article of food.

CHAPTER XIII.

POISONING BY THE ALKALIES AND THEIR SALTS.

Potash, soda, and their carbonates. Pearlash, soap-lees.—The *symptoms* produced by these substances when taken in a strong

dose, are so similar, that one description will serve for all. It must be observed that cases of alkaline poisoning are extremely rare, and have been, I believe hitherto, the result of accident. The patient experiences, during the act of swallowing, an acrid, caustic taste from the alkaline liquid excoriating the mucous membrane. There is a sensation of burning heat, extending down the œsophagus to the epigastrium. Vomiting is not always observed; but when it does occur, the vomited matters are sometimes mixed with blood of a dark brown colour, and detached portions of membrane:—this effect depending on the degree of causticity in the liquid swallowed. The surface is cold and clammy:—there is diarrhea with severe pain in the abdomen, resembling colic. The pulse is quick and feeble. In the course of a short time, the lips, tongue and fauces, become swollen, soft and red. *Post-mortem appearances.* There will be strong marks of the local action of the poison on the mucous membrane of the mouth, fauces and œsophagus. It has been found softened, detached and inflamed in patches of a deep chocolate colour,—sometimes almost black. The same appearance has been met with in the mucous membrane of the larynx and trachea. The stomach has had its mucous surface eroded in patches, and there has been partial inflammation. *Period of death.*—The earliest fatal case which I have found reported, is that of a boy, who died in three hours after swallowing three ounces of a strong solution of carbonate of potash. In another case which occurred at Yarmouth, in 1835, a child aged three years, took a small quantity of pearlash, which had deliquesced, and died in twenty-four hours. Death was caused in this instance, by the inflammation induced in the larynx, causing an obstruction to the process of respiration. In this respect, the caustic alkalies may destroy life like the mineral acids. But death may be a slow result of the poison. Thus in an instance which was lately communicated to me, a lady swallowed by mistake, one ounce and a half of the common solution of potash of the shops, which contains but very little caustic alkali. She recovered from the first symptoms of irritation; but died seven weeks afterwards, from pure exhaustion, becoming greatly emaciated before her death. Orfila refers to two cases of poisoning by carbonate of potash, in each of which, half an ounce of that substance was taken by mistake for aperient salts. The patients, two young men, recovered from the first effects; but ultimately died, the one three months, and the other four months after the poison had been taken. The secondary fatal effects appear to be due to diarrhea, great irritability of the stomach, loss of the functions of that organ from the destruction of the lining membrane,—and stricture of the œsophagus,—either of which causes may prove fatal at almost any period. The *quantity* of any of these alkaline poisons, required to destroy life, is unknown. *Treatment.*—We may administer freely, water containing acetic or citric acid dissolved,—lemon juice, or the juice of oranges. Demulcent drinks, as milk, gruel, or barley-water, will also be found serviceable. Oil has been found useful.

AMMONIA. SESQUICARBONATE OF AMMONIA.—The vapour of strong ammonia is poisonous. It may destroy life by producing violent inflammation of the larynx, and pneumonia. It is often most injudiciously employed to rouse persons from a fit. A case is on record, of an epileptic having died under all the symptoms of croup, two days after the application of strong ammonia, in this way, to the nostrils. A very singular case of recovery from the poisonous effects of this vapour, by Dr. Sanchard, will be found in the Annales D'Hygiène, Janvier, 1841.

The solutions of ammonia and its sesquicarbonate produce symptoms, similar to those described in speaking of potash. The only difference observed, is that the sense of heat and burning pain in the throat, fauces and stomach, is much greater. Cases of this description are rare. Dr. Sanchard relates an instance which occurred recently in France, where a boy, only six years old, poisoned his younger sister, by pouring several teaspoonfuls of strong solution of ammonia down her throat. A case is likewise reported where a strong dose of the solution killed a man in *four minutes*. (Christison, 167.) The solution of sesquicarbonate of ammonia, (sal volatile,) is probably more active as a poison, than is commonly supposed. The following case occurred to my knowledge in 1832. A man, in a fit of passion, swallowed about five fluid-drachms of a solution of sal volatile. In ten minutes, he was seized with stupor and insensibility; but upon the application of stimulant remedies, he recovered. He suffered for some time afterwards from severe irritation about the fauces and œsophagus. A case has lately been tried in which a man was charged with the murder of a child by administering spirits of hartshorn. *Reg.* v. *Haydon*, Somerset Spring Assizes, 1845. Of the action of the other salts of ammonia on man, nothing is known.

CHEMICAL ANALYSIS.—The three caustic alkalies, potash, soda and ammonia, are known from the solutions of the alkaline earths by the fact, that they are not precipitated by solution of carbonate of potash. They all three possess a powerful alkaline reaction on test paper, which in the case of ammonia, is easily dissipated by heat. *Ammonia* is immediately known from potash and soda, by its odour and volatility. If the solution in water be very dilute, the odour may be scarcely perceptible. The alkali may then be discovered, provided we have first assured ourselves, by evaporating a portion of the liquid, that potash and soda are absent,—by adding to the solution a mixture of arsenious acid and nitrate of silver. The well-known yellow precipitate of arsenite of silver will be instantly produced. The same result takes place when a phosphate is present, but if a phosphate existed in the liquid it would be left on evaporation. In addition to these characters, ammonia re-dissolves the brown oxide of silver, which it precipitates from the nitrate, while potash and soda do not. The *Sesquicarbonate of ammonia* may be known from other salts by its alkaline reaction, its odour, and its entire volatility as a solid:—from pure ammonia:—1, by its effervescing on being added to an acid;—2, by its yielding an abundant white precipitate with a solution of muriate of lime;—from the carbonates of potash and soda, among other properties, 1, by its giving no precipitate with a solution of the sulphate of magnesia; 2, from the rich violet blue solution, which it forms when added in excess to the sulphate of copper; 3, by its odour and volatility.

Caustic potash and soda are best known from their respective carbonates by giving a brown precipitate with a solution of nitrate of silver. The carbonates, on the other hand, yield a whitish yellow precipitate. Caustic potash is known from caustic soda by the following characters. 1. Its solution is precipitated of a canary-yellow colour. by bichloride of platina. 2. It is precipitated in granular white crystals, on the addition of an excess of a strong solution of tartaric acid, or by digesting in it a large crystal of tartaric acid. Caustic soda is not precipitated by either of these tests, which will serve equally to distinguish the salts of potash from those of soda, if we except the binoxalate and bitartrate of potash, which are not precipitated. 3. If we neutralize the two alkalies by dilute nitric acid, and crystallize the liquid on a slip of glass, should the alkali be potash, the crystals will be in the form of long slender fluted prisms; if soda, of rhombic plates. 4. A fine platina wire may be dipped into the alkaline liquid, and then dried by holding it above the flame of a spirit-lamp. In this way, a thin film of solid alkali is obtained on the wire. On introducing this into the colourless part of the flame; if it be potash, the flame will acquire a rose or lilac colour; if soda, a rich yellow colour. This test applies to the salts of the two alkalies, care must be taken that the platina wire is perfectly clean. When the quantity of alkali or alkaline salt is large, the experiment may be performed in a platina capsule.

The *Carbonates* of potash are known from those of soda by the above tests. The carbonate is known form the bicarbonate of either alkali, by the fact that the former yields immediately a white precipitate, with a solution of sulphate of magnesia, while the latter is unaffected by that test.

In liquids containing organic matter.—Such liquids will possess an alkaline reaction. If the alkali be ammonia, this will be announced by the odour, and it may then be obtained by distillation. If the alkali be in small proportion, this can afford no evidence of poisoning; since many animal fluids contain the alkali, and in those which do not contain it, it is easily generated either by spontaneous decomposition, or sometimes even by the heat required for distillation. Should the alkali be in large quantity, this is no evidence of poisoning by it, unless we at the same time discover obvious marks of its local action on the mouth, fauces, œsophagus and stomach. If the organic liquid be highly alkaline, but give out no odour of ammonia, either by itself or on distilling a portion with caustic potash, the alkali may be either potash or soda, or their carbonates. The latter would be known by the liquid effervescing on adding a portion to an acid. The organic liquid may be evaporated to dryness, then heated to char the animal and vegetable matter, and the alkali will be recovered from it in the state of carbonate by digesting the residuary ash in distilled water. It has been also recommended to neutralize by muriatic acid, to evaporate, incinerate, and procure the alkali for analysis in the state of chloride. Traces of these alkalies furnish no evidence, since all the animal liquids and solids yield soda, and many of them potash. In no case will the discovery of the alkalies be any proof of poisoning, unless the marks of their action be apparent in the fauces and stomach.

There are certain salts of potash, to which poisonous effects have been attributed. It will be necessary, therefore, to consider these briefly.

Iodide of Potassium. (Hydriodate of Potash.)—This is extensively employed as a medicinal preparation, but it appears to have given rise in some instances, to alarming symptoms, even when exhibited in small doses; and death has been said to result from its use. The following cases will perhaps best serve to illustrate its effects. A gentleman was ordered by his physician to take three grains of the

iodide in a draught of peppermint water three times a day. After the third dose, he felt poorly; and an hour after the fourth dose he was attacked with a violent shivering fit, followed by headache, hot skin, intense thirst, quick and full pulse, vomiting and purging. These symptoms were succeeded by great prostration of strength. In spite of treatment the purging lasted several days. The effects of the medicine in this case were so violent, although only *twelve grains* had been taken, that there is little doubt, if the patient had taken another dose, he would have been killed. (Med. Gaz. Sept. 3, 1841.)

In October, 1841, a case was reported by Mr. Ericksen to the University College Medical Society, in which very alarming symptoms resulted from the exhibition of only *five grains* of iodide of potassium. There was great difficulty of breathing; discharge from the eyes and nostrils, inflamed conjunctivæ, and most of the symptoms of violent catarrh. The iodide was discontinued, and the patient recovered. Dr. Lawrie found that seven grains and a half of the iodide in three doses, produced in an adult, dryness and irritation of the fauces, great difficulty of breathing, and other serious symptoms. In another case, thirty grains in divided doses, caused severe headache and secretion of tears. In two instances, wherein he had prescribed it medicinally in small doses, it was, in his opinion, the cause of death. (Med. Gaz. xxvi. 588.) These cases at least show the necessity of caution in the medicinal use of this substance. The effects may, perhaps, be attributed to idiosyncrasy. Still there seems to be good ground, from the results of experiments on animals, for ranking iodide of potassium among irritant poisons. It has not, as far as I know, caused death, if we except the two cases reported by Dr. Lawrie. One drachm and a half of the solution has been taken by a young female without destroying life, although it produced very serious symptoms of irritation. (Devergie, Méd. Lég. ii. 536.) It has been suggested that the occasional adulteration of the iodide with carbonate of potash, may account for the discrepant statements as to its poisonous properties. In one instance, in which the medicinal dose had been carried to several drachms, the iodide was found to contain seventy-five per cent of carbonate.

Chemical analysis.—Iodide of potassium is a white solid salt, crystallizing in cubes, like common salt. It is very soluble in water. In the *solid* state: mix with it a small quantity of peroxide of maganese and moisten the powder with equal parts of strong sulphuric acid and water,—then heat the mass in a glass tube. The purple vapour of iodine is immediately evolved. If the tube be of small diameter, the quantity which may be thus easily detected, is exceedingly minute. If the iodide be in *solution*, add to the clear liquid an equal part of a solution of starch, and then a dew drops of strong nitric acid. The blue colour of the iodide of farina produced, will show that the salt is an alkaline iodide. This test is extremely delicate. The potash may be detected by decomposing the salt at a high temperature with strong sulphuric acid, when sulphate of potash will result.

In organic liquids.—If much coloured, boil with animal charcoal until the colour is in great part or entirely removed; then add to the liquid a

solution of starch in large quantity, and afterwards nitric acid. As a trial test, we may employ a slip of filtering paper soaked in starch, then dipped into the suspected liquid and exposed to the fumes of nitric acid. In this case, the colour of the liquid does not interfere with the experiment. By this process, the iodide may be detected in the urine, when the analyst may not succeed in finding it in the contents of the stomach. If present in organic solids, we must dry them, incinerate them, and lixiviate the incinerated residue, when traces of the iodide may be detected by starch and nitric acid. The following is the result of an experiment. Ten grains of iodide of potassium were dissolved in six ounces of porter, mixed with an ounce of thick starch. The mixture was evaporated to dryness, the residue incinerated and lixiviated with one ounce of water. The solution was neutral. One drop containing one-fiftieth of a grain of iodide, gave a deep pink red colour with starch and nitric acid. Iodide of potassium, it is well known, undergoes absorption, and is carried into the secretions and all the soft organs in which it may be detected by the above process if not found in the stomach.

There is no antidote to this poison. It should be removed as speedily as possible by the stomach-pump.

Sulphurets of Potassium and Sodium. (Liver of sulphur.)—These compounds are seen as uncrystalline solids of a red or red brown colour. They form yellow solutions in water which have an alkaline reaction and are highly poisonous. No case of poisoning by them has occurred in England; but two fatal cases are reported to have occurred in France. The symptoms were—burning pain in the stomach, vomiting and convulsions. In one case the patient died in about a quarter of an hour, and the stomach and duodenum were found inflamed after death. It was observed that the breath of the patient, was tainted with the odour of sulphuretted hydrogen gas.

Analysis.—When *solid*, sulphuretted hydrogen is abundantly evolved, on adding diluted muriatic acid to the powdered sulphuret; and the alkali remains as a chloride. When in *solution*, subacetate of lead gives an intense black precipitate, by which the sulphuret may be identified in the smallest proportion.

Nitrate of potash. (Nitre. Saltpetre.)—This well-known salt is largely employed in the arts. It is an irritant, but only acts as such when taken in a large dose. It has destroyed life on several occasions. Its effects are somewhat uncertain. An ounce, and even two ounces have been taken without causing very alarming symptoms. (Ed. M. and S. J. xiv. 34.) Dr. Bennett states that M. Gendrin was in the habit of giving it in doses varying from six to twelve, or sixteen drachms in the twenty-four hours without any injurious effects resulting. (Med. Chir. Review, April, 1844, 549.) Tartra denied that it had poisonons properties even in a very large dose, (op. cit. 135,) but cases have occurred which now leave no doubt on the subject. In one instance, quoted by Orfila, an ounce of nitre was taken by a lady in mistake for other salts. In a quarter of an hour, she suffered from nausea, vomiting and purging, and the muscles of the face were convulsed. The pulse was weak, — the respiration laborious, and the

extremities cold, but there was a sense of burning heat and severe pain in the epigastrium. She died in *three hours* after taking the dose. On dissection, the stomach was found highly inflamed, and the membrane detached in various parts. Near the pylorus, the inflammation had a gangrenous character. A large quantity of liquid coloured by blood, was found in the stomach. (1, 283.) In another case, which proved fatal in sixty hours where an ounce and a half of nitre had been taken, a small perforation was found in the stomach. (ib.)

My friend, Dr. Geoghegan of Dublin, has communicated to me the following case, which is of recent occurrence. A man took from an ounce to an ounce and a half of nitre by mistake for salts. Severe pain in the abdomen followed, with violent vomiting, but no purging so far as could be ascertained. He died in about *two hours* after taking the salt. On examination, a bloody mucus was found in the stomach,—the lining membrane was of a brownish red colour, generally inflamed, and in parts detached from the coat beneath. None of the poison was detected in the stomach, but its nature was clearly established from the analysis of a portion left in the vessel which had contained the draught.

Poisoning by nitre has been hitherto the result of accident. It is never taken for the purpose of suicide, the popular opinion being, that it is not poisonous; although the above cases show that it destroys life with greater rapidity than is commonly observed in the action of arsenic and corrosive sublimate. It is never likely to be employed by a murderer, since a dose sufficient to kill could not be secretly exhibited.

Two men swallowed, each, one ounce of nitre by mistake for Glauber's salt. They almost immediately experienced a sense of coldness in the course of the spine, trembling in the limbs, with violent vomiting and purging. The stools were bloody. They recovered in the course of a few days. (Casper's Wochenschrift, xviii. 1841.) A case is reported in the same journal, where one ounce of nitre killed a man in thirty-six hours.

Chemical analysis.—See Nitric Acid, (antè, p. 85.) Orfila states that he has detected nitre in the liver, spleen, kidneys and urine of animals poisoned by it. Ann. D'Hyg. 1842, ii. 434.

Sulphate of potash.—This salt, commonly regarded as inert, has lately given rise to an important medico-legal investigation in France. A lady, about a week after her delivery, took, by the prescription of her medical attendant, about ten drachms of the sulphate of potash in divided doses, as a laxative. After the first dose, she was seized with severe pain in the stomach, nausea, vomiting, purging and cramps in the extremities. These symptoms became augmented after each dose, and she died in *two hours*. It was supposed that some poison had been given by mistake; but that was not the case, and the question was, whether her death was caused by the sulphate of potash. On inspection, the mucous membrane of the stomach and intestines, was found pale, except the valvulæ conniventes, which were red-

dened. The stomach contained a large quantity of reddish coloured liquid, which, on analysis, was found to contain only sulphate of potash, and no trace of any common irritant poison. The examiners referred death to the sulphate of potash given in an unusually large dose, whereby it had acted as an irritant poison in a person whose constitution was already much debilitated. (Ann. D'Hyg. Avril, 1842.)

The question whether this is to be regarded as a poisonous salt, of an irritant nature, has been much debated within the last year among members of the profession, owing to a case which was tried at the Central Criminal Court in October, 1843. (The *Queen* v. *Haynes.*) The prisoner had given to the deceased, the night before her death, two ounces of sulphate of potash, dissolved in water; and it was alleged that she had, a fortnight previously to this, taken, in divided doses, as much as a quarter of a pound of the salt. The woman supposed herself to be pregnant, which was disproved by an examination of the body; and it was charged that the prisoner had given her the salt with the intention of causing a miscarriage. After the last dose, she was seized with sickness, and died within a very short time. The stomach was found empty, but highly inflamed, and there was blood effused on the brain. One medical witness referred death to the action of this salt as an irritant poison; the other to apoplexy, as an indirect result of the violent vomiting caused by the salt. The prisoner was acquitted of the charge of murder, but subsequently found guilty of administering the drug with intent to procure abortion. Both of the witnesses admitted that, in small doses the salt was innocent; but that in the dose of two ounces it would produce dangerous effects. A portion of the sulphate in this case was examined by Mr. Brande, as it was suspected that some poisonous substance might have become accidentally mixed with it; but it was found to be pure.

It is not improbable, from the symptoms and the inflamed state of the stomach, that the salt acted here as an irritant poison; and the fact of its being an innocent medicine in small doses appears to be no sound objection to this view; for the same circumstance is observed with respect to many substances, the poisonous properties of which cannot admit of dispute. Some have ascribed the irritant properties of this and other saline medicines—such as cream of tartar, in large doses—to their insolubility, and to the fine spicula of the powdered salt acting mechanically upon the mucous membrane of the stomach. This explanation does not appear sufficient: 1st, because some of these saline medicines, when taken dissolved—such as alum and nitre—have had a similar action; and, 2d, the effects are very different, and far more rapidly fatal than in those cases where mechanical irritants—such as fine sand or iron filings—have been taken. In short, there is no doubt that if the same quantity of the salt were taken perfectly dissolved in water, it would have an equally irritant effect; and sulphate of potash has been known to act in this way, when taken in divided and therefore in very soluble doses. A case in which it thus proved fatal in *two hours,* has been already reported (suprà.) According to Mr. Mowbray (Medical Gazette, xxxiii. p. 54,) sulphate of potash is a salt much employed in France as a popular abortive. He quotes several instances in which, in large doses, it produced severe symptoms, re-

sembling those of irritant poisoning, and even death. In one case, two drachms acted powerfully; and in another, that fell under his own observation, four drachms of the salt, administered to a lady after her confinement, had all the effects of an irritant poison. The case of Haynes is the first instance in which, I believe, it is publicly known to have proved fatal in England; and it shows that substances, commonly regarded as innocent, may give rise to important questions in toxicology.

There is no doubt that the most simple purgative salts may, under certain circumstances and when given in large doses, destroy life. I have already related a case (antè, p. 2,) in which sulphate of magnesia caused death, and gave rise to a criminal charge in this country. It is said that sulphate of potash has in some cases caused vomiting and other serious symptoms, from its containing as impurity, sulphate of zinc. This would be easily discovered by adding the ferrocyanate of potash, which precipitates zinc.

CHEMICAL ANALYSIS.—Sulphate of potash is easily identified. It is a dry hard salt, soluble in water, forming a neutral solution. This solution if sufficiently concentrated, is precipitated both by tartaric acid and bichloride of platina, whereby potash is indicated; and the presence of sulphuric acid is known by the action of a salt of barytes. In *organic liquids*. This salt being insoluble in alcohol, may have the organic matter removed from it by treating the liquid containing it (previously concentrated) with alcohol. Or the substance containing the salt may be evaporated to dryness and incinerated, when the sulphate may be obtained by lixiviating the calcined residue with distilled water. The sulphate of potash exists naturally in some animal fluids, but only in traces.

SULPHATE OF ALUMINA AND POTASH. (ALUM.)—This substance is very commonly known; but it does not appear to have given rise to many accidents at least in this country. One case of death from alum appears in the Registration report for 1838-9. A singular case occurred in Paris, in 1828, in which the alleged noxious properties of alum were brought into question. A lady swallowed a quantity of calcined alum dissolved in warm water, which had been supplied to her by mistake for powdered gum. The quantity taken was less than half an ounce. She immediately complained of a burning pain in the mouth, throat and stomach. She afterwards suffered from thirst, violent vomiting, and general disturbance of the system, from which she recovered in the course of two or three days. These effects were referred to the alum, and the party who supplied it by mistake, was condemned to a severe punishment. On the case being carried to an appeal, Orfila contended that alum was not a poison; although he admitted that in the calcined state it was a caustic, and in order to establish his opinion of its inertness, he offered to swallow half an ounce on the spot! He referred the symptoms under which the party laboured to some other cause, but on being further questioned, he admitted that a solution of calcined alum was likely to produce more serious effects than common gum, which the party should have taken.

The punishment was mitigated. (Ann. D'Hyg. 1829. i. 234.) Orfila has since found that alum operates fatally on animals, destroying life in the course of a few hours. He states that he detected the salt in these cases in the substance of the stomach, liver, spleen, and in the urine. (Ann. D'Hyg. 1842, ii. 433.) The reader will find a singular case of supposed poisoning by alum in the Ann. D'Hyg. 1832, ii. 180.

We cannot therefore avoid admitting the possibility of this substance acting as an irritant, on the same principle on which we admit the irritant properties of salts of a far more innocent character. It is, however, proper to observe, that this salt, given in large doses to animals, does not appear to affect them seriously unless the œsophagus be tied: *three drachms* have been taken by patients at a dose, dissolved in six ounces of liquid, without any inconvenience resulting.

Chemical analysis.—Common alum possesses a peculiar and astringent taste. It easily dissolves in water, forming an acid solution, which crystallizes on evaporation in regular octohedra. Its solution is not affected by ferrocyanate of potash or sulphuretted hydrogen, whereby it is known from the true metallic saline solutions. Its sulphuric acid may be detected by a salt of barytes. On adding potash, a white precipitate of alumina falls down, which is redissolved by adding a larger quantity of the alkali. By this last character, it is known from the alkaline earths which are precipitated from their solutions by potash, but are not redissolved. On adding ammonia in excess, alumina falls down. This may be separated by filtration, and on evaporating the liquid portion, and incinerating the saline residue, there will be found sulphate of potash. Calcined alum is a white uncrystalline substance, only partially soluble in water. The quantity dissolved is, however, sufficient to allow its nature to be determined.

Chloride of sodium. (Common salt.)—For the alleged poisonous properties of this substance, see antè, p. 2. These effects have been ascribed to the presence of iodide of sodium or arsenic, but pure salt may undoubtedly act as an irritant. It is exceedingly important in a medico-legal view it should be known that arsenic has been found in salt as a fraudulent admixture. See Ann. D'Hyg. 1830, ii. 432; also 1832, ii. 288.

Chemical analysis.—This has been referred to in the description of the processes for detecting muriatic acid. On this account, as well as from the fact, that it has already caused death when administered in a large dose, (antè, p. 2,) it may be proper to mention the chemical characters by which it may be identified.—1. It is easily dissolved by water, and a portion of the solution slowly evaporated on a slip of glass, yields well-defined *cubic* crystals.—2. It is insoluble in alcohol.—3. It yields abundant acid vapours with a kind of effervescence, when strong sulphuric acid is poured on it. These vapours form a dense white solid cloud, when a rod dipped in strong ammonia is brought near to them.—4. It yields chlorine gas when heated with equal parts of sulphuric acid, water, and peroxide of manganese:—the chlorine being recognised by its usual characters. About one-twentieth of a grain of the chloride may be in this way analysed, if the experiment be performed in a proportionately small tube.—5. The solution of the salt gives an abundant white clotted precipitate with nitrate of silver—possessing all the chemical properties of chloride of silver.. These properties of the precipitate must be positively determined, since there are numerous other salts which are preci-

pitated white by nitrate of silver. These experiments, it will be perceived, merely indicate the presence of chlorine or muriatic acid. The characters of soda have been already given, p. 109. A chloride is also known by boiling it in a solution of arsenious acid and sulphuric acid, and immersing a slip of bright copper—if the salt be a chloride, the copper is covered with a grey coat of arsenic.

BARYTA AND ITS SALTS.—These are undoubtedly poisons, but very little is known concerning their action on the human subject. Pure baryta itself is a caustic alkali, which is not likely to be taken as a poison, seeing that it is rarely met with out of a chemical laboratory. The principal salts are the chloride, nitrate, acetate and carbonate, the last of which is insoluble in water. The sulphate, from its great insolubility, is said not to be poisonous; but it would be well that this should be established by experiment, since insolubility is no criterion whatever of a substance being inert; although it is often erroneously assumed to be so, and the doctrine of chemical antidotes is chiefly founded on this view. Calomel and arsenite of copper are as insoluble as the sulphate of barytes, and yet are known to have a very powerful action on the body.

The only two preparations of baryta that have yet caused death, are the chloride and the carbonate. One case of poisoning by the *chloride*, is reported by Wildberg. The symptoms were those of irritation, combined with an affection of the brain and nervous system;—vertigo, convulsions and paralysis, have been remarked among them. In the case referred to, half an ounce proved fatal in two hours. In another instance, one ounce taken by mistake for Glauber's salt, destroyed life in *an hour*. In small doses even, it has been found to affect the system powerfully. Orfila has satisfied himself that the chloride of barium is absorbed. He states that he has detected it in the liver, spleen and kidneys of animals poisoned by it. (Ann. D'Hyg. 1842, ii. 217.) The *carbonate* of baryta is said to have destroyed life in two cases, in each of which only one drachm was taken; but the following case which occurred to Dr. Wilson, shows that this compound is not so poisonous as the chloride.

A young woman swallowed half a tea-cupful of the powdered carbonate, mixed with water, at a time when she had been fasting for twenty-four hours. There was no particular taste. In two hours, she experienced dimness of sight, double vision, ringing in the ears, pain in the head, and throbbing in the temples, with a sensation of distension and weight at the epigastrium. There was also palpitation of the heart. After a time she complained of pain in the legs and knees, and cramps in the calves. She vomited twice, a fluid like chalk and water. The skin was hot and dry, the pulse frequent, full and hard. These symptoms gradually abated, and she recovered, although the pain in the head and epigastrium continued for a long time. (Med. Gaz. xiv. 448.) The *acetate* of baryta would, no doubt, prove an active poison; but it is not much known.

TREATMENT.—The alkaline sulphates, either of soda or magnesia,

should be exhibited freely in water; but, unless the patient is seen early, no treatment is likely to avail. The sulphates render the baryta less soluble, and certainly diminish, if they do not altogether destroy its poisonous properties. They will be of little service where the carbonate has been taken. In this case emetics and the stomach-pump may be used. As a chemical antidote to the carbonate, a mixture of vinegar with an alkaline sulphate may be employed. It would of course be improper to administer dilute sulphuric acid, and any other acid would render the poison more soluble.

Chemical analysis.—A solution of pure baryta possesses an alkaline reaction like potash, soda, and ammonia; but it is known from these three bodies, by its being precipitated white by a solution of carbonate of potash. This last-mentioned agent precipitates equally lime and strontia, but among numerous other characters, baryta is known from lime by sulphuric acid, which precipitates baryta, but not lime. Sulphuric acid also precipitates a solution of pure strontia, but baryta is known by the action of a solution of sulphate of lime. This precipitates baryta immediately, but not strontia.

The soluble salts of baryta possess these characters in common: 1. They are precipitated white by sulphuric acid or an alkaline sulphate, even when considerably diluted; those of lime are not precipitated, and those of strontia are very slowly precipitated when the respective solutions are diluted. 2. Diluted solutions of the salts of baryta are not precipitated by oxalic acid; those of strontia and lime are precipitated, even when much diluted with water. Oxalate of ammonia will throw down the salts of the three bases, unless the solution of the barytic salt be exceedingly diluted, when no precipitate is formed in it, or if formed it is easily redissolved by oxalic acid. Solutions of the salts of strontia, and lime when equally diluted, are, however, readily precipitated by oxalate of ammonia, and the precipitate is not soluble in oxalic acid. 3. The powdered salts of baryta, when burnt on a platina wire in the flame of alcohol, give a greenish yellow-colour; those of strontia and lime give a rich crimson red. This experiment applies only to the soluble salts. The acids of the salts are known by their respective tests. The chloride of barium, by the action of nitrate of silver. The nitrate of barytes, by precipitating the solution with sulphate of potash and obtaining nitre from the filtered liquid, by at once adding to a saturated solution of the salt, copper filings and an excess of strong sulphuric acid, or by adding it in powder to the sulphate of narcotine. The carbonate of baryta, by its dissolving with effervescence in diluted nitric acid, and the action of the proper tests on the resulting soluble nitrate. Lastly, the acetate, by boiling the solution with the diluted sulphuric acid, when acetic acid escapes, easily known by its odour. The solution of this last-mentioned salt is known from the other soluble salts of baryta by its being precipitated when concentrated, by tartaric acid, in an excess of which it is soluble as well as in a large quantity of water.

In *organic liquids*.—If the salt of baryta be dissolved, a good trial test is diluted sulphuric acid. This gives an abundant white precipitate should the poison be present in any quantity. We may then throw down the whole of the poison by an alkaline sulphate,—separate this by filtration, dry it and incinerate it with the organic matter. In this way, it will be converted to sulphuret of barium, which may be decomposed by washing it with diluted muriatic acid, when chloride of barium, in a state fit for testing, will be obtained. It is proper to observe, that pure baryta and its salts are very apt to be confounded with subacetate of lead and other compounds of that metal. A clear distinction consists in this: the salts of lead are blackened by hydrosulphuret of ammonia—those of baryta are not. Besides sulphate of lead is easily soluble in concentrated muriatic acid, while sulphate of baryta is quite insoluble in that acid.

Strontia and Lime have but little interest for the medical jurist. Lime is said to have destroyed life in one instance; and there is no doubt that both of these bases, as well as their salts, may have an irritant action, but they have not the directly poisonous effects of baryta and its compounds. The following case of Poisoning by lime is extracted from Casper's Wochenschrift.

A boy aged three years while playing tasted some slacked lime and ate a considerable quantity of it. An emetic was given, and he brought up a mortary looking substance. The child became restless and feverish, had thirst, refused food, his lips were white, the mouth blackish, the belly hot and painful on pressure, and there were bloody evacuations. A few leeches were applied, and he recovered. (Med. Gaz. xxxv. 64.)

In medico-legal analyses, their salts may be mistaken for those of baryta, as they are in many respects similar. Great caution should therefore be used, when a mixture alleged to be poisoned with a salt of baryta, is presented for examination. For a summary of the most remarkable chemical differences in respect to the action of liquid tests, see pòst,—table of alkaline poisons.

Phosphorus and Phosphoric Acid. It is not often that we hear of cases of poisoning by phosphorus or its compounds, but the following instance has been reported by Mr. Shephard of Stonehouse. (Lancet, Dec. 1843.) A child, between two and three years of age, had been caught in the act of sucking and swallowing the heads of lucifer matches. Two days afterwards she appeared unwell, there was some feverish excitement, but no active symptoms. The bowels were open, but the child did not suffer from pain, vomiting, or diarrhea. Five hours after she was first seen, she became violently convulsed, and she died three hours afterwards. On inspection, a quantity of mucus mixed with blood, of a coffee-ground colour, was found in the stomach. The mucous membrane of the organ was very vascular throughout, and for the space of about two inches it had a florid red colour, and was covered with mucus. There were no less than ten invaginations in the small intestines, many of which included from two to three inches of intestine, which was inflamed at the invaginated parts. There was no appearance of strangulation, and the bowels were empty. The medical opinion given at the inquest was that phosphorus, in a finely divided state, was the cause of death, and a verdict was returned accordingly.

Another case is reported in the same journal, (Sept. 14, 1844,) in which phosphorus given as a medicine proved fatal to a boy aged ten years. The deceased had taken phosphorus in pills and in an oleaginous mixture for nearly four weeks by a medical practitioner. When seen he was lying in a state of stupor quite insensible, labouring under strong convulsions, hurried breathing, and a small pulse. He died some hours afterwards. The principal appearances were congestion of the brain, a bright vermillion colour of the anterior surface of the stomach externally, with softening of the mucous membrane

within,—and the marks of violent irritation and inflammation of the muscular coats of the large intestines. The quantity of phosphorus taken was not stated, as it was given in divided doses. None had been given for ten days previous to death, nevertheless this was probably due to the long continued use of the substance. The stomach contained two ounces of a coffee-ground liquid and a large quantity of mucus.

A singular case is reported by Dr. Graff in which a young woman swallowed the phosphorus contained in about three hundred matches, rather less than *five grains* of pure phosphorus, and recovered from the effects. The symptoms do not appear to have been very severe, a fact ascribed by the reporter to the phosphorus having been in an intimate and probably insoluble state of combination with other substances in the matches. Mr. Shephard's case above related, shows that this explanation is inadmissible, and we must look upon this, admitting the dose to be correctly represented, as a very remarkable instance of recovery. (Henke Zeitschrift. 1842, ii. 283.) For another interesting case of poisoning by phosphorus, see Casper's Wochenschrift, 31 May, 1845.

So few cases of poisoning by phosphorus have occurred, that we are scarcely in a position to generalize upon its effects. It appears to be a powerful irritant poison, but operates with some uncertainty, and it has been generally after many days that it has destroyed life. The symptoms are also exceedingly protracted in their appearance. Thus it is only after many hours, and sometimes one or two days, that signs of irritation and other alarming symptoms appear, among which convulsions and spasms have been remarked; but when these once come on, the case proceeds rapidly to a fatal termination. That it is a very active poison is proved by two cases quoted by Dr. Christison (188). In one death was caused by a grain and a half in twelve days: in the other by two grains in about eight days. It is supposed to operate as a poison only by becoming converted to phosphoric acid; but this is extremely doubtful. Dr. Glover found that *fifty grains* of glacial phosphoric acid dissolved in two drachms of water and administered to a rabbit produced no effect. Ed. Med. and S. J. lviii. 121. But a person has been killed by a quantity of phosphorus (case suprà) equal to less than *three and a half* grains of phosphoric acid.

The TREATMENT would consist in the administration of magnesia with emetics and purgatives.

CHEMICAL ANALYSIS.—*Phosphorus* is so easily known by its physical properties and ready inflammability at low temperatures, as to render any test unnecessary. If in a finely divided state, it may be boiled in one part of nitric acid and two of water until dissolved,—by this it is converted to phosphoric acid, which may be obtained sufficiently pure for testing by evaporating nearly to dryness at a low temperature and redissolving in water. In one instance, the contents of the stomach when dried and rubbed, appeared luminous in the dark. *Phosphoric Acid* in solution. But one test is required, i. e. Nitrate of silver. This gives a milky opacity with phosphoric acid,—which is changed to a light yellow precipitate on the addition of a few drops of a weak solution of am-

monia. The phosphoric might in this respect be confounded with arsenious acid, but it is easily known from this poison, 1, by its giving no deposit on copper when boiled with muriatic acid,—and 2, no yellow precipitate when treated with sulphuretted hydrogen gas For phosphoric acid in the solid state or as procured in the way above described, i. e. by digesting a suspected powder in nitric acid and evaporating to a syrup, the following is a test which will detect the acid in the minutest quantity, even when mixed up with other bodies which resist the effects of heat. Evaporate to a syrup in a platina capsule, and add finely powdered muriate of ammonia, at the same time applying a high temperature by a spirit lamp. If phosphoric acid be present, it will escape in dense white flakes as a volatile and strongly acid vapour (pyrophosphoric acid) plainly distinguishable from the white vapour of muriate of ammonia.

This concludes the account of the non-metallic inorganic irritants. We shall now pass to the description of the metallic irritant poisons, which it may be observed are distinguished from the preceding by the fact that they are all precipitated by sulphuretted hydrogen gas, or by the hydro-sulphuret of ammonia, and most of them by a solution of ferrocyanide of potassium.

CHAPTER XIV.

ON POISONING BY ARSENIC.

The term WHITE ARSENIC is commonly applied to the arsenious acid of chemists. Arsenic acid is another compound which is highly poisonous, but has never, so far as I know, been used for the purposes of suicide or murder. YELLOW ARSENIC, or orpiment, is the sesquisulphuret of chemists. This is also poisonous, apparently because it contains a large portion of arsenious acid, which has not combined with sulphur. This has been on two or three occasions criminally used as a poison. White arsenic, or arsenious acid, is however that preparation which chiefly requires the attention of a medical jurist. In the years 1837-8, there were one hundred and eighty-five cases of poisoning by the substance, this greater number of which were the result of suicide and murder.

As a witness may sometimes have to infer quantity from the cost, it may be stated that from half an ounce to one ounce of white arsenic is sold for twopence—one ounce and a half for threepence—if exceeding this, the charge is at the rate of one shilling a pound. I state this on the authority of a highly respectable retail house in London.

White arsenic is commonly seen under the form of a white powder, or in opake masses resembling enamel. It is called an acid from its power of combining with alkalies, but it possesses a very feeble acid reaction when dissolved in water. It is often described as having

an acrid *taste,* but this appears to be an error; a small quantity of it has scarcely any appreciable taste, a fact which may be established by direct experiment. It would also appear from numerous cases on record, that it has been unconsciously taken in large quantities, in all descriptions of food, without exciting the least sensation on the tongue. Most of those persons who have been criminally or accidentally poisoned by arsenic, have not been aware of any taste in taking the poisoned substance. Certain it is that the taste has not been perceptible when the poison has been given in wine, milk, beer, and other simple liquids, or many lives would have been saved. With facts of this kind, it is extraordinary that Orfila should persist in asserting that arsenious acid has "a sharp, not corrosive, but somewhat styptic taste perceptible after a few seconds, very persistent, and exciting salivation in a marked degree." i. 377. He does not state this, however, upon his own experience. This error has had its influence on the medical evidence given in numerous cases of arsenical poisoning during the last half century.

Arsenic is an irritant poison : it does not seem to possess any *corrosive* properties, i. e., it has no chemical action on the animal tissues, and the changes met with in the alimentary canal of a person poisoned by it, are referrible to the effects of the inflammation excited by the poison, and not to any chemical action. I have not found that arsenic produces any effect on dead mucous membrane, like those poisons which are properly called corrosive. In an important case (*Waring's,*) tried at the Leicester Lent assizes, 1842, the medical witnesses were closely pressed to say whether arsenic was or was not a corrosive poison; the deceased having been killed by arsenic in a few hours, and the changes in the stomach being unusually well marked. They properly referred these changes to the violence of the inflammation, and not to the chemical action of the poison.

The *solubility* of this substance in liquids is a frequent question on trials. The action of water is materially influenced by circumstances. I have found by numerous experiments, (Guy's Hospital Reports, No. 4,) that hot water cooling from 212^0 on the poison in powder, dissolves about the 400th part of its weight. This is in the proportion of nearly one grain and a quarter of white arsenic to about one fluid ounce of water. Water boiled for an hour on the poison and allowed to cool, holds dissolved the 40th part of its weight, or about twelve grains to one ounce. Cold water allowed to stand for many hours on the poison, does not dissolve more than from the 1000th to the 500th part of its weight; i. e., one-half grain to one grain of arsenic to nearly one fluid ounce of water. The presence of organic matter in a liquid, considerably impairs its solubility. Thus, hot tea or brandy will not dissolve more than one-half grain to the fluid ounce. Liquids, which are at all viscid or mucilaginous, may suspend the poison in almost any quantity, but in these cases it cannot be said to be dissolved. The solubility of arsenic is a matter of frequent medico-legal inquiry. (See the important case of the *Queen* v. *Hunter,* tried at the Liverpool

Lent Assizes, 1843:—two medico-legal reports of which have been published, the one by Mr. Holland, and the other by Mr. Dyson of Manchester.) It is often necessary to determine whether the quantity taken was sufficient to kill. In reference to its solubility in cold water, I have found that where the quantity dissolved was not more than one-half grain to one ounce, i. e., less than the 1000th part—the solution had neither taste nor any acid reaction whatever. The proportions are here stated in round numbers. A medical witness is often asked the weight of common or familiar measures of arsenic in powder. I may therefore state that from experiment, I have found a tea-spoonful of powdered arsenic to weigh 150 grains,—a table-spoonful to weigh 530 grains,—and a pinch, or the quantity taken up between the finger and thumb of an adult, to weigh 17 grains. These weights are here given as the results of actual experiment: they are liable to vary. The exact weight of a fluid ounce of water is also subject to great variation in the measures used by druggists. The solubility of arsenious acid is said to be increased by admixture with nitre, and its action is then rendered more energetic. (Med. Times, Dec. 1844.)

Symptoms.—These will vary according to the form and dose in which the poison has been administered. The *time* at which they come on is generally in from half an hour to an hour after the poison has been swallowed. This is the average period. I have known them to appear in a quarter of an hour. Dr. Christison mentions one instance in which the symptoms began in eight minutes; but in the case of Lofthouse, tried at the York Lent assizes, 1835, the symptoms were proved to have attacked the deceased, while he was in the act of eating the cake in which the poison was administered. On the other hand, in an instance reported by Orfila, the symptoms did not show themselves for five hours. And another is mentioned by Dr. Lachèse where a large dose was taken in which the symptoms did not appear for *seven* hours. (Ann. D'Hyg. 1837, i. 344.) In the opinion of Dr. Christison, the symptoms may be retarded by sleep.

The individual first experiences faintness, nausea and sickness, with an intense burning pain in the region of the stomach, increased by pressure. The pain in the abdomen becomes more and more severe; and there is violent vomiting of a brown turbid matter mixed with mucus and sometimes streaked with blood. These symptoms are followed by diarrhea, which is more or less violent. There is a sense of constriction, with a feeling of burning heat in the throat, often accompanied by intense thirst. The pulse is small, very frequent, and irregular, sometimes wholly imperceptible. The skin is cold and clammy in the stage of collapse, at other times it is very hot. The respiration is painful from the tender state of the abdominal parietes. Before death, coma sometimes supervenes with tetanic convulsions and spasms in the muscles of the extremities.

Such is the ordinary character of the symptoms in an acute case of arsenical poisoning, i. e. where from half an ounce to an ounce of the poison has been taken; but should the person recover from the first

effects, and the case be protracted, or should the dose have been small and frequently administered, there will be inflammation of the conjunctivæ, with suffusion of the eyes, and intolerance of light,—a condition which is, however, often present with the early symptoms above described. There is also irritation of the skin, accompanied by an eruption, which has been called eczema arsenicale; paralysis and other symptoms of nervous disorder. Exfoliation of the cuticle and skin of the tongue with the falling off of the hair has likewise been witnessed (case of the Turners, 1815, Marshall, 119.) Salivation has been observed to follow, where small doses of the poison have been given for a length of time. Med. Gaz. xvi. 790. Strangury and jaundice have also been observed. (Marshall on Arsenic, 44. 111.)

The whole of these symptoms may not be met with in every case. Thus the pain, which is usually excruciating, like a fire burning within the body, is sometimes absent. In a well-marked case of poisoning which occurred in October, 1839, from one ounce to two ounces of arsenic were taken; there was no pain except of the most trifling character just before death. It has been supposed that this symptom was absent where the dose was large; but a case occurred in Guy's Hospital in 1836, where only forty grains had been taken, and the patient died without complaining of pain. There are many similar instances on record. The symptoms of alvine irritation are seldom wanting, or there is vomiting, if there should be no purging. In one case of criminal poisoning by arsenic, in which I was consulted by Mr. Veasy, which was tried at the Bedford Spring assizes, in 1842, there was neither vomiting nor purging. The quantity of poison taken must have been very small. Great thirst is a common symptom, but this is sometimes absent. It is necessary for a medical jurist to attend to these anomalies, as otherwise the symptoms of arsenical poisoning may be easily mistaken for those of disease. (See case by Dr. May, Prov. Med. Journal, July, 1845.)

The following case, quoted by Belloc, is in this point of view remarkable. A young woman with the design of committing suicide procured a lump of arsenic. She began by biting it, but as she could not procure sufficient in this way, she broke it up into coarse fragments, put them into a glass of water and swallowed them. This was in the morning and she went the whole of the day without suffering any marked uneasiness. At six o'clock in the evening she was seen by M. Laborde,—and there were then no febrile symptoms. At eight o'clock she suffered from pain in the abdomen. At eleven o'clock she appeared to be more calm than ever, and had a strong desire to sleep. At three in the morning she sat up in her bed complained a little of her stomach, and then died without the least appearance of suffering. She vomited some fragments of arsenic before death. On opening the stomach the vessels were found gorged and there were coagula of blood in the folds of the mucous membrane at the cardia. There were marks of excoriation about the lips, mouth and œsophagus. (Cours de Méd. Lég. 122.)

This is in every point of view a most remarkable case. No one acquainted with the usual effects of arsenic could have suspected it to be a case of arsenical poisoning. It therefore most strikingly shows, as Belloc observes, the absolute necessity for post-mortem inspections in all unexplained cases of death. The symptoms were probably more protracted in their appearance

than in any other instance yet recorded, not having manifested themselves, as we may infer, until *ten hours* after the taking of the poison. They appear to have been at no time severe—there is no account of diarrhea having been among them—they underwent a complete remission before death, and the deceased expired as from the effects of a narcotic about seventeen hours after taking the poison.

POST-MORTEM APPEARANCES.—The striking changes produced by arsenic, are generally confined to the stomach and intestines. They are commonly well marked in proportion to the largeness of the dose and the length of time which the individual has survived after taking the poison. Our attention must first be directed to the stomach. Arsenic seems to have a specific effect on this organ; for, however the poison may have entered into the system, whether through a wounded or ulcerated surface, or by the act of deglutition, this organ has been found inflamed. Inflammation of the stomach cannot, then, be always considered to be dependent on the local irritant action of the poison on that organ. A case is reported in a late number of Rust's Magazin, where a man covered his head with arsenic in powder, to act as a depilatory. He was affected with the usual symptoms of arsenical poisoning, excepting diarrhea; and he died on the *twentieth* day. Ths interior of the stomach, as well as the lower part of the œsophagus, was generally inflamed.

Fatal illustrations of arsenic thus destroying life when applied externally, are by no means unfrequent. Two cases of its operating fatally in children when applied to the skin of the head for tinea capitis, will be found in the Annales D'Hygiéne, 1830, ii. 437. In both, the mucous membrane of the stomach was found inflamed, and in one extensively. A trial has recently taken place in England (*Reg.* v. *Port*, Chester Winter Assizes, 1844,) in which a man pretending to cure cancer, was charged with the death of a female by the application of an arsenical plaster, as it was supposed, to the breast. The woman died in a fortnight. No satisfactory evidence was obtained of the symptoms during life, except that there had been vomiting; and the accused had taken care to remove the plasters, so soon as serious symptoms began to appear,—hence there was no direct chemical evidence of the nature of the substance actually employed. This case, however, shows the great utility of the late discovery respecting the absorption of arsenic into the body. Dr. Brett of Liverpool was able to detect the absorbed arsenic in the substance of the stomach, liver, and spleen,—the quantity detected was less than a quarter of a grain. The œsophagus, stomach, and intestines were found extensively inflamed. Notwithstanding this evidence, which appears to have been particularly clear, the prisoner was acquitted. The learned judge, in charging the jury, observed, "that the quantity of arsenic was exceedingly small," (see antè, p. 57,) although why *any* arsenic should be found in the stomach, liver, and spleen of a human being simultaneously with extensive inflammation of the stomach and bowels after the application of a plaster (not produced) to a diseased breast, is entirely unexplained! We can only suppose, admitting the verdict to be correct, that the arsenic found was spontaneously generated by some mysterious process in the tissues of the body, and that the inflammation of the alimentary canal was a mere coincidence! In January, 1845, a man in this city died apparently from the effects of arsenic absorbed through the skin of the arm. He was engaged in the manufacture of candles to which arsenic was added in large proportion, and it was supposed that an abrasion of the skin had facilitated the absorption of the poison. The medical opinion given at the inquest, was decidedly that the deceased had died from the effects of arsenic, thus introduced into the system. The external application of or-

piment in the form of ointment has also caused death. (See SULPHURETS OF ARSENIC, post.) Belloc states that he employed arsenical compounds externally to scirrhous tumours of the eye, cheek, and nose, without any serious consequences resulting. (Cours de Méd. Lég. 121.)

The mucous membrane of the stomach is commonly found red and inflamed; the colour, which is sometimes of a dull or brownish red, becomes brighter on exposure to the air; at other times it is of a deep crimson hue, interspersed with black-looking striæ of altered blood. The redness is usually most strongly marked at the greater extremity; in one case it may be found spread over the whole mucous surface, giving to it the appearance of red velvet,—in another it will be chiefly seen on the prominences of the rugæ. Blood of a dark colour is effused in various parts between the rugæ, or beneath the lining membrane, an appearance which has been mistaken for gangrene. The stomach often contains a mucous liquid of a dark colour tinged with blood. The coats are sometimes thickened in patches, being raised up into a sort of fungous-like tumour, with arsenic imbedded in them,—at other times they have been found thinned. The mucous membrane is rarely found ulcerated, and still more rarely gangrenous. Perforation of the coats is so uncommon a result of arsenical poisoning, that there are only three instances on record. The duodenum and rectum are those parts of the intestines which have been generally found inflamed; and traces of inflammation are occasionally seen in the pharynx and œsophagus. The mucous glands of the stomach have been found enlarged; but this is by no means an unusual morbid appearance without reference to poisoning. Various morbid appearances are said to have been met with in the lungs, heart, brain and urinary organs; but they do not appear to be characteristic of arsenical poisoning. It is undoubtedly to the stomach and intestines, that a medical jurist must look for the basis of medical evidence in regard to post-mortem appearances.

A witness is often asked in a Court of law how long a time is required after the taking of the poison for the production of these well marked appearances in the stomach, more especially of inflammation of the mucous membrane. On this point I am enabled to present the following facts. In a case which I lately had to examine, a large dose of arsenic had been taken;—the man, aged twenty-one, died in five hours, and the stomach was found intensely inflamed, especially about the greater curvature. In a case that occurred to Mr. Thompson of Nottingham, half an ounce of the poison was taken; the patient died in six hours, and the stomach was found uniformly red and inflamed. In another that occurred to Dr. Booth of Birmingham, the same quantity of arsenic was taken; the patient died in six hours and a half: on inspection the œsophagus was inflamed, and the whole internal surface of the stomach was of an intense scarlet colour; and there was redness and increased vascularity of the duodenum, jejunum and ileum. In *Waring's* case already referred to, (p. 121,) where but a

small quantity of arsenic could have been taken, the whole of the stomach and intestinal canal was found highly inflamed, although the deceased could not have survived *four hours*. Mr. Foster of Huntingdon has favoured me with an account of three cases in which the poison was taken at the same time; and death occurred in one, a child, at the end of *two hours:* in the second, an adult, at the end of *three hours and a half;* and in the third, after the lapse of about six hours. In all of these, the stomach was found highly inflamed, and in the one that proved fatal in two hours, the mucous membrane had a vermilion hue. This last I believe to be the shortest period at which inflammation of the stomach from the effects of arsenic, has been met with.

Another question put to a witness may be this,—What period is required for ulceration of the mucous membrane to take place, as an effect of this poison? If arsenic has destroyed life with unusual rapidity, and the stomach is found ulcerated, an attempt may be made to refer this ulceration to some other cause. (Guy's Hospital Reports, Oct. 1841, p. 283.) Dr. Christison remarks that ulceration is hardly to be looked for unless the patient has survived two days. In the case of *Rhymes*, which was the subject of a criminal trial in 1841, (G. H. R. suprà,) I found ulceration of the mucous membrane, although the deceased survived the effects of the poison only ten hours. The deposition of the arsenic in and around the ulcers, as well as the appearance of recent inflammation about them, left no doubt that they had been produced by the poison, and were not owing to previous disease, as it was attempted to be urged in defence. When no arsenic is found in the stomach, a defence of this kind will carry with it considerable plausibility. In *Waring's* case, a medical witness was questioned upon this point. The deceased is stated to have died from the effects of arsenic in *four hours;* the coats of the stomach were found ulcerated, but no poison could be detected in the organ. The witness admitted on cross-examination that it was contrary to all experience that ulceration should be occasioned by an irritant poison in less than four hours; but he nevertheless very properly contended that this was the true cause. In short, we must, on such points, be guided by observation; and one case of this kind, is sufficient to place the possibility of ulceration being produced by arsenic within a few hours, beyond all question. But are the stomach and intestines always found inflamed in cases of poisoning by arsenic? The answer must be decidedly in the negative. At the trial of *M'Cracken*, at the Derby Autumn assizes, in 1832, for killing his wife with arsenic, the fact of poisoning was clearly established, and a large quantity of arsenic was found in the stomach of the deceased; but there was no appearance of inflammation, either in that organ or the intestines. In a late number of Rust's Magazin, I find the two following cases. A servant girl had some arsenic administered to her in chocolate. She was seized with nausea and violent pain in the stomach, and died the same evening. On inspection there was no remarkable vascularity or inflammation of

the stomach ;—but arsenic was found in the duodenum. A man was taken ill with vomiting and violent pain in the abdomen after partaking of some soup, and he died from symptoms of poisoning. On inspection, the mucous surface of the stomach presented no morbid change, with the exception of slight redness about the cardia. Arsenic was found in the contents of the intestines. See also another interesting case by Dr. May, Prov. Med. Journal, July 16, 1845.

Occasionally the appearances are so slight, that were not the attention of the examiner specially directed to the fact of poisoning, they would be passed over. These singular cases appear to show, that arsenic does not exert any local action of a chemical nature, like a corrosive, on the stomach ; for the action of corrosives takes place on mere contact, without reference to the state of constitution or the quantity of poison taken. Medical evidence of poisoning from post-mortem appearances, is in such cases entirely wanting ;—they are not very common, but still they show, that unless great care be used in forming an opinion, a case of arsenical poisoning may be easily overlooked. They teach this important fact in legal medicine, that the non-existence of post-mortem changes, is no proof that the party has not died from the effects of arsenic.

It is worthy of remark in relation to the known antiseptic properties of arsenic, that the parts specially affected by this poison, (the stomach and intestines,) occasionally present the well-marked characters of irritant poisoning for a long time after death. This was established in the case of the *Queen v. Dazley,* tried at the Bedford Summer assizes, July, 1843. The prisoner was convicted of poisoning her husband with arsenic, upon evidence obtained by the exhumation and examination of the body six months after interment. The stomach and intestines were the only parts of the body undecomposed. This case presents many important subjects for reflection to the medical jurist ; as for example, the substitution of arsenic for medicine,—the length of time after death at which good evidence may be obtained from the body,—the fact of another person labouring under symptoms of poisoning by arsenic, who had accidentally partaken of the supposed medicine—and lastly, the evidence from the death of an animal which had swallowed some of the matter vomited by the deceased.

Quantity required to destroy life.—This is also an important medico-legal question. According to a case quoted by Dr. Christison, the smallest fatal dose on record, in an adult, is stated to have been *thirty* grains of the powdered white arsenic : the man died in six days. But undoubtedly a much smaller quantity than this would kill. Facts of this description, can of course only be elicited by accident ; as in cases of suicide or murder, so much more of the poison, than is necessary, is commonly taken. The smallest fatal dose of arsenic in a state of solution, is stated to have been *four grains and a half*—the child who took it, died in six hours. (Christison, 295.) In *Waring's* case, it was highly probable from the medical evidence that the deceased, an old woman of seventy, was killed by *four* grains. In a case

that lately fell under my notice, I have reason to think that a young lady was killed by eating a portion of cake which could not have contained more than *four* grains of arsenic, and probably less than three grains. There is no doubt that very small doses of this poison are capable of producing serious effects; and that some constitutions may be more affected by it than others. Dr. Burne has reported the case of a young female, who took in divided doses in three days, one-fifth of a grain of arsenic. Symptoms of inflammation of the stomach and alarming symptoms of a nervous character appeared, which rendered a discontinuance of the medicine absolutely necessary. One case, however, is reported in which one drachm of arsenite of potash in solution, equal to half a grain of arsenic, was swallowed with comparative impunity. (Pharm. Journal, April, 1845.)

The following case occurred in London, in October, 1839. At a large dinner party, it was observed that three persons, who had partaken of the port wine on the table, were seized with symptoms of poisoning. The wine was suspected to contain poison, and it was sent to me for examination. It was clear, of the usual colour and odour, and possessed all the characters of good wine; but there was a small quantity of a reddish white sediment at the bottom of the bottle. From the account of the symptoms, the wine was suspected to contain arsenic:—this was found to be the case, and the quantity of poison dissolved, amounted to about 1·2 grain in each fluid ounce. The following were the facts. A child aged sixteen months, took a quantity of the wine containing about one-third of a grain of arsenic. In twenty minutes this child became sick, vomited violently for three hours, and then recovered. A lady, aged fifty-two, took a quantity of wine, containing rather less than *two grains* of arsenic. In about half an hour, she experienced faintness. Violent vomiting came on and lasted four hours, but there was no pain. She then gradually recovered. A gentleman, aged forty, took a quantity of the wine containing rather more than *two grains* of the poison. The symptoms in him were similar, but more severe; and had he taken another glass of the wine, it is probable he would have been killed. It may be proper to observe, that although this wine was perfectly saturated with arsenic, not the least taste was perceived by any of the parties.

This case shows that two grains of arsenic have been taken without causing death, but it is not thence to be inferred that two grains, or even less, may not suffice to destroy life. As Dr. Christison justly remarks, the two adults may have here owed their escape to the fact, that the poison was taken on a full stomach and that there was violent vomiting. From the symptoms produced, we shall certainly be warranted in asserting, that a dose of *three grains* is very likely to prove fatal to an adult. According to Dr. Lachese, from one to two grains may act fatally in a few days. This, however, is a speculative opinion, (Ann. D'Hyg., 1837, i. 334.) It is highly probable that this dose would prove fatal to a child, or to weak and debilitated persons. Sometimes the examination of a witness on this question may take a very rambling course, and embrace veterinary jurisprudence. A friend of mine who lately gave evidence at a criminal trial for poisoning by arsenic, was asked to state what quantity would poison an elephant! In relation to dose, it is necessary for a medical jurist to remember that persons have recovered after having taken very large doses of this poison.

A case is reported, in which sixty grains were taken by a physician, who recovered without suffering very severely. (Med. Gaz. xi. 771.) In another instance, a person recovered after having taken half an ounce of arsenic. The stomach pump was not used, and the arsenic appears to have been carried off by vomiting and purging. Cases of recovery where so large a dose has been taken, are not very common. (Med. Gaz. xix. 238.) They must be regarded as exceptions to the general rule. It would be in the highest degree improper to infer from them that large doses of this poison may be taken with impunity. In these cases, we commonly find that the arsenic has been taken on a full stomach, or it has been speedily ejected by vomiting and purging.

PERIOD AT WHICH DEATH TAKES PLACE.—Large doses of arsenic commonly prove fatal, in from eighteen hours to three days. Probably, the average time at which death takes place, is twenty-four hours. But the poison may destroy life within a much shorter period than this. There are many cases reported in which death has taken place in from three to six hours. I have very recently (1845) met with a well-marked case of death from arsenic in five hours. For another case see Ann. D'Hyg., 1837, i. 339. It is singular that a few years since, observations were so limited, that it was thought to be impossible for arsenic to destroy life in a shorter period of time than seven hours! (see ante, p. 39, *Russell's case*;) and this rapidity of death was actually considered as a medical fact, which in some measure tended to negative the allegation of death from arsenic! One of the most rapidly fatal cases on record, I believe to be that which occurred to Mr. Foster, (ante, p. 126.) This gentleman satisfactorily ascertained that the subject, a child under three years of age, died within *two hours* from the effects of arsenic. The quantity taken could not be determined: but I shall presently adduce some facts to show that the time at which death takes place, is not strictly dependent on the quantity of poison taken. Dr. Borland informed me of the case of a woman where death took place, with equal rapidity. Two ounces of arsenic were taken and the patient died in less than *two hours* afterwards in a fit of syncope. The case was remarkable in other points:—there was neither pain, vomiting, nor diarrhea. A case of poisoning by arsenic, but somewhat doubtful, is reported by Metzger to have proved fatal in *half an hour*. The patient died in convulsions. (System der Ger. Arzneiw, 256.) In these instances of rapid death the brain and nervous system have been observed to be frequently affected;—the patient suffering from narcotism and convulsions: but this by no means implies that symptoms of irritation are always absent. A case was communicated to the London Medical Review, (April 1811, p. 188,) by Mr. Soden of Coventry, which shows, that with a large dose of arsenic and rapid death, there may be violent symptoms of gastric irritation, and few or no symptoms indicative of nervous disorder. The case is otherwise remarkable from the enormous quantity of poison taken. A man aged twenty-two, purchased seven ounces of finely-powdered arsenic, and swallowed, between seven and eight o'clock in the morning, not

less than four and probably six ounces of the poison. In about half an hour he was found vomiting;—there was severe pain in the abdomen, rapid pulse, and slight convulsions of the legs. In two hours, diarrhea supervened, and there was constant inclination to pass urine:—the pain in the bowels became most intolerable,—the convulsive motions of the limbs more frequent, and the pulse more feeble, but still very quick. According to the antidotal doctrines, at that time prevalent, sulphuret of potash (potassium) was largely exhibited to him. He died in *less than four hours,* "after a dreadful fit of convulsive laughter," his limbs becoming suddenly rigid. In this case, there appear to have been no comatose symptoms whatever. On inspection, the stomach was found highly inflamed, "the mucous coat looked as though it had been beautifully injected," and two ounces of arsenic were found in the cavity of this organ. We have here an instance, which occurred in March 1810, of arsenic destroying life and producing excessive inflammation in less than four hours: and yet at a criminal trial, sixteen years afterwards, (Lewes assizes, 1826,) it was a debated question with some of the medical witnesses, whether it was possible for a person to die from the effects of arsenic in less than seven hours, and respectable authorities were actually quoted against this view! Such is the danger of a Court of justice relying for medico-legal facts of this description, upon the personal experience of witnesses.

An interesting case has been recently published by Dr. Dymock. A girl, aged twenty, took two ounces of powdered arsenic, and died in less than two hours and a half afterwards. There were no comatose symptoms:—the girl was sensible to the last, and she had vomited violently. The mucous membrane of the stomach was covered with bright patches of a scarlet colour. (Ed. Med. and Sur. Jour. April 1843.) In thirteen cases of poisoning by arsenic recorded by Dr. Beck, the smallest quantity taken was one drachm, and the largest two drachms. The shortest period for death was four hours, the longest two days. (Dub. Med. Press, May 1845.)

With respect to the effect of quantity, I have known one case prove fatal in fifteen hours where forty grains had been taken; and in another, where an ounce (twelve times the above quantity) had been swallowed, the patient did not die for seventeen hours. Both patients were females of about the same age. It is a common opinion that large doses only, kill with great rapidity; but that is not uniformly observed. In one instance, two ounces of the poison destroyed life in three hours and a half; but in another case *(Waring)* a dose of four or five grains killed a person in four hours. It is obvious that a patient who recovers from the first effects, may still die from exhaustion or other secondary consequences, many days or weeks after having taken the poison. In one criminal case in which I was consulted, the child did not die from the effects of arsenic until after the lapse of two days. In the case *Reg. v. M'Cormick,* Liverpool Winter assizes, the child died, as it appeared, from one dose of arsenic after the lapse of twelve days. (Med. Gaz. xxxiii. 434.) The child partially recovered

from the first effects. In the case of the *Queen v. Gilmour*, (Edinburgh, Jan. 1844,) the deceased died after thirteen days. In one case, already mentioned, arsenic was applied externally to the head, and the person did not die until the twentieth day.

TREATMENT.—If vomiting does not already exist as a direct effect of the poison, sulphate of zinc may be exhibited, and the emetic effects promoted by mucilaginous drinks, such as linseed tea. When sulphate of zinc cannot be procured, a good substance for an emetic is powdered mustard, in the proportion of from one to two teaspoonfuls, in a glass of water, administered at intervals. A saponaceous liquid, made of equal parts of oil and lime-water, may also be given. While this invests the poison, the lime acts in some degree as a chemical antidote; although as arsenic is usually taken in the form of a coarse powder, and is very little soluble, chemical antidotes are not of much use. The stomach-pump may be usefully employed; but unless the patient is seen early, remedial means are seldom attended with success. I have known death to occur in a case where every particle of poison was found, on subsequent examination, to have been removed from the stomach. There are many instances of recovery on record, in which the arsenic appears to have been early ejected by constant vomiting and purging. The recovery, has, however, been commonly attributed to the supposed antidote.

The *hydrated sesquioxide of iron* (prepared by precipitating a strong solution of persulphate of iron by ammonia, and washing away part of the alkali) has been of late years strongly recommended as an antidote. It is said to form an insoluble arsenite of iron, but according to Dr. Maclagan, it requires twelve parts of oxide as a hydrate, and sixty parts when dried, to combine with and neutralize *one* part of arsenious acid. Again the insoluble combination is not found to be perfect, unless ammonia be present, and Dr. Christison considers that a triple compound is formed of arsenious acid, ammonia, and a large excess of oxide of iron. Taddei and Orfila, (1, 365,) have found that arsenite of iron is itself a poison, only less active than arsenious acid from its being less soluble. Others have found that it is entirely destitute of antidotal powers. Dr. Cramer administered arsenic to ten rabbits, and employed the oxide of iron as a counter-poison but without any good results. (Schneider's Ann. 1836, i. 455.) In performing many experiments on this antidote in order to determine its value in a chemical point of view, I have obtained the following results. 1. When the arsenious acid is perfectly dissolved in water and mixed and agitated with twelve or fifteen times its weight of the hydrated oxide, the poison is precipitated with it in a very insoluble form, and on drying it is not readily separable by volatilization from the oxide. 2. When the poison is mixed and agitated in the state of *powder* with the oxide, there is little or no effect. The poison becomes mechanically diffused through the oxide and is readily obtained by volatilization from the dried powder in which the grains of arsenious acid are easily distinguishable. No more is

precipitated than cold water will dissolve, i. e. about one five hundredth part. 3. When the poison in powder is mixed with oxide of iron rendered alkaline by ammonia, so much appears to combine with the iron, as the quantity of alkali present will render soluble in cold water. The rest is diffused in granules through the oxide.

Most of the experiments in favour of this antidote, have been performed on clear and *filtered* solutions of arsenic; and therefore the results are perfectly irrelevant; since arsenic is in almost all cases taken in *powder* and often in very coarse powder. It is said that the oxide of iron may act in the stomach by preventing the absorption of the arsenious acid; but it is not easy to perceive how this can happen without a chemical combination, which is proved not to take place between the two insoluble substances out of the body. If arsenious acid be sprinkled over an extensive ulcer and then covered with hydrated oxide of iron, it is not likely that absorption would be prevented, and the remark applies equally to the mucous membrane of the stomach to which arsenic is often very closely adherent. Besides it would be contrary to all we know of the operation of antidotes, that chemical effects are to be produced between two insoluble substances in the stomach, which cannot be obtained by direct experiment out of it. If the poison were swallowed in the state of a filtered aqueous solution, the oxide of iron might combine with it; but then its antidotal effects are so imperfect, that unless administered instantly and in a very large proportion, it could be of no benefit; for it is obvious that in such a state of perfect solution, arsenic would act with very great rapidity. Numerous recoveries are said to have occurred under the use of this alleged remedy, but so far as I have been able to ascertain, in severe cases, emetics and the stomach-pump were also freely used; and in the lighter cases, recovery would probably have equally taken place without it. Recoveries were said to take place formerly, under the use of the alkaline sulphurets, or of carbonate of magnesia. In the case of the *Turners* (1815), five persons recovered from the effects of arsenic, under treatment which we should now look upon as highly injurious. (Marshall on Arsenic, 106.) It appears probable that in this, as in other cases of poisoning, too much importance has been attached to the effect of the supposed antidote, and too little assigned to the efforts of nature and the simultaneous employment of emetics and the stomach-pump. It is upon the use of these evacuants that we must chiefly rely, in treating a case of arsenical poisoning. Viscid or mucilaginous liquids may be also freely exhibited, as these will serve to suspend the poison mechanically, and to sheathe the coats of the stomach from its action. More recently the acetate of the sesquioxide of iron has been recommended by Dr. Duflos. In experimenting with this, I have found that in respect to arsenic in *powder*, it is as inefficacious as the hydrated oxide even where an alkali is added to produce effectual precipitation; and that with regard to the *solution* of arsenious acid, the poison is more readily precipitated by the hydrated oxide than by the acetate of iron.

Chemical analysis.—In the *simple state*, as a *solid*, white arsenic may be identified by the following properties: 1. A small quantity of the powder, placed on platina foil, is entirely volatilized at a gentle heat in a white vapour. Should there be any residue, it is impurity; sometimes plaster of Paris is said to be mixed with it. The quantity of fixed impurity present, may in this way be easily determined. If a small portion of the white powder be very gently heated in a glass tube of narrow bore,—it will be sublimed, and form a ring of minute octohedral crystals, remarkable for their lustre and brilliancy. It will be observed in these experiments, that white arsenic in vapour, possesses no odour. 2. On boiling a small quantity of the powder in distilled water, it is not dissolved, but it partly floats in a sort of film, or becomes aggregated in small lumps at the bottom of the vessel. It requires long boiling, in order that it should be dissolved and equally diffused through water. This is an important fact. See the case of *Reg.* v. *Lever*, Central Criminal Court, June, 1844. A question here arose, whether arsenic would float on tea. I have observed that the film formed on putting arsenic into a vessel of cold water remained for five weeks on the surface, notwithstanding the occasional agitation of the vessel. On adding a few drops of caustic potash to the water and applying heat, the arsenic is entirely dissolved, forming a clear solution of arsenite of potash. 3. When a portion of the powder is treated with a solution of hydrosulphuret of ammonia in a watch-glass, there is no change of colour, as there is with most metallic poisons; on heating the mixture, the white powder is dissolved; and on continuing the heat until the ammonia is expelled, —a rich yellow or orange-red film is left, (sesquisulphuret of arsenic,) which is soluble in all alkalies. 4. When a small portion, i. e. from one-fourth to one-twentieth part of a grain, is heated with some reducing agent containing carbon, in a glass tube about three inches long and one-eighth of an inch in diameter, it is decomposed; a ring of metallic arsenic of an iron-grey colour is sublimed and deposited in a cool part of the tube. At the same time, there is a perceptible odour resembling that of garlick, which is possessed by metallic arsenic in a state of vapour. This *odour* was at one time looked upon as peculiar to arsenic, but no reliance is now placed on it, as a matter of medical evidence; it is a mere accessory result. Many mistakes were formerly made respecting this odour. Thus, we find it stated to have been perceived under circumstances in which it could not possibly have been produced! (Marshall on Arsenic, 90, ed. 1817.) It was not then known, that white arsenic (arsenious acid) possessed no odour in the state of vapour. In this experiment, there are commonly two rings deposited in the tube, the upper of which has a brown colour, and appears to be a mixture of finely divided metallic arsenic and arsenious acid. It has been regarded by some as a suboxide, more volatile than the metal. Various reducing agents have been proposed: for example, charcoal, black-flux, calcined cream of tartar,—the oxalate of lime or soda—the formate of soda; but that which I have found most convenient is the residue of the tartrate or acetate of soda (incinerated in a covered platina crucible) which consists of carbon and carbonate of soda. It does not deliquesce and may be kept for years without change. The proportion in which it should be employed in the reduction, is about two or three parts of flux to one of white arsenic. Cyanide of potassium has been lately recommended; it answers very well, but it is apt to become moist. I have found that gallic acid is a deoxidizing agent, but it is not equal to the soda flux.

If it be necessary to determine the weight of the sublimate, the glass tube should be filed off closely on each side of the metallic ring, and weighed; the sublimate may then be driven off by heat, and the piece of glass again weighed. The difference or loss represents the weight of the sublimate. These sublimates are remarkably light, and require a delicate balance. I found in one experiment a large sublimate to weigh no more than ·08 gr. By heating gently the piece of tube broken up in another of larger diameter, the metallic arsenic in being volatilized, forms octohedral crystals of arsenious acid, which may be dissolved in a few drops of water and tested. When the quantity of ar-

senious acid is so minute as to be scarcely ponderable, it would be advisable to employ for its reduction, finely powdered and dry charcoal, since the alkali in the soda-flux would retain the whole or the greater part of the arsenic in combination. The minute quantity of arsenious acid, should be dropped into a dry and warm tube, not more than the eighth or the tenth of an inch in diameter, and the charcoal, well dried, dropped on it in the proportion of three or four times its bulk. The upper part of the charcoal should be brought to a high temperature before the arsenic is heated. In this way, distinct arsenical sublimates may be procured weighing considerably less than the 1000th part of a grain. The delicacy of this test cannot be estimated by the weight of the sublimate, but by the weight of the arsenious acid, on which we can operate. Dr. Christison states that a distinct metallic sublimate may be obtained from the 300th part of a grain (260). These sublimates may be preserved for years by filing off the end of the tube, and then hermetically sealing it in the flame of a spirit lamp.

Objections.—Corrosive sublimate is volatile like white arsenic, but it differs from it in all its other properties. It is very soluble in water, insoluble in potash, which turns it of a yellow colour,—while hydrosulphuret of ammonia turns it black. Indeed it may be said that there is no substance but arsenic which possesses the *three* first characters mentioned; they should, however, be taken together. With regard to the fourth character, namely, the production of a metallic sublimate, there have been numerous objections: 1. The glass itself may acquire a black metallic lustre by heat from the reduction of the oxide of lead contained in it. This is always the case when the tube is held too much in the body of the spirit-lamp flame instead of over the point. This metallic stain differs in appearance from arsenic; it is fixed, while the arsenical sublimate is volatile by heat, and convertible to octohedral crystals of arsenious acid. 2. Charcoal may give a dark colour to the tube, but it is not advisable to employ this substance, unless the quantity of arsenious acid be very minute; besides the stain of charcoal is fixed, and has no metallic lustre like that of arsenic. 3 Arsenic is said to be contained in glass, and it was supposed that it might be sublimed by heat; that, however, is impossible: arsenic is used in the manufacture of glass, but it is entirely volatilized during the process. (See Ann. D'Hyg., 1834, i. 224.) 4. Cadmium is a metal which is said to form a metallic sublimate like arsenic. The oxide of cadmium may be reduced by a similar process, but the metallic sublimate is wholly different from that of arsenic; it has a tin-like lustre, and is generally fringed with a brown margin of reproduced oxide. There is no odour of garlick during the reduction of oxide of cadmium, and on heating the metallic ring, it is not wholly volatilized like arsenic, but converted to a ring of brown oxide. Oxide of cadmium is of a brown colour,—it cannot be volatilized on platina by the heat of a spirit-lamp; it is quite insoluble in potash, but easily dissolved by nitric acid. If there were no perceptible difference in the sublimates produced by the two bodies, these characters would at once form a clear distinction between them. Oxide of cadmium is moreover a very rare substance, it is difficult to meet with it. 5. Mercury forms a sublimate; but in white silvery globules, quite distinct from the dark iron-grey lustre of arsenic. Neither antimony nor zinc can be volatilized from any of their preparations in a metallic state, by the heat of a spirit-lamp. The test of reduction with the most simple precautions, is, therefore, when thus applied, conclusive of the nature of the substance under examination. It is advisable, although not absolutely necessary, that we should apply the three foregoing tests to the white powder, before attempting to extract the metal from it.

With respect to the other properties of arsenic it may be remarked,—that it is very soluble in boiling muriatic acid, and by this means it may be separated from the sequisulphuret or orpiment, which is not dissolved by that acid. The solubility of arsenious acid in muriatic acid, aids the deposition of the metal on copper in a way to be presently explained. It is not dissolved by nitric acid, but is oxidized by it on long boiling, and converted

to arsenic acid; and lastly, it is soluble in alcohol, and is not precipitated by this reagent from liquids in which it is dissolved. The presence of neutral salts does not appear to affect its solubility in water. Nitre is said to render it more soluble.

Arsenic in solution in water.—The solution is clear, colourless, possesses scarcely any perceptible taste, and has a very faint acid reaction. In this state, we should first evaporate a few drops on a glass plate, slowly, when a confused crystalline crust will be obtained. On examining this crust with a common lens, it will be found to consist of numerous minute octohedral crystals, presenting triangular surfaces by reflected light. By this simple experiment, arsenic is distinguished from every other metallic poison. 1. On adding to the solution,—*Ammonio-nitrate of silver*,—a rich yellow precipitate of arsenite of silver falls down:—rapidly changing in colour to a greenish brown. The test is made by adding to a very strong solution of nitrate of silver, a weak solution of ammonia, continuing to add the latter, until the brown oxide of silver, at first thrown down, is almost re-dissolved. The yellow precipitate is soluble in nitric, tartaric, citric and acetic acids, as well as in caustic ammonia. It is not dissolved by potash or soda. 2. On adding to the solution of arsenic, *Ammonio-sulphate of copper*, a rich green precipitate is formed, the tint of which varies, according to the proportion of arsenic present and the quantity of the test added; hence if the quantity of arsenic be small, no green precipitate at first appears: the liquid simply acquiring the blue colour of the test. In less than an hour if arsenic be present a bright green deposit is formed which may be easily separated from the blue liquid by filtration. This test is made by adding ammonia to a solution of sulphate of copper, until the blueish white precipitate, at first produced, is nearly re-dissolved: it must not be used in large quantity if concentrated, as it possesses a deep violet blue colour, which renders obscure, the green precipitate formed. The precipitated arsenite of copper is soluble in all acids, mineral and vegetable, and in ammonia, but not in potash or soda. When dried and collected, it possesses this valuable property:—by very slowly heating a few grains in a tube of small bore,—arsenious acid is subblimed in a ring of minute resplendent octohedral crystals,—oxide of copper being left as a residue.

These are called the liquid tests for arsenic. The silver test, first discovered by Mr. Hume, in 1789, (Marshall on Arsenic, 87,) acts with remarkable delicacy, and is of great use as a corroborative test in the various processes for determining the presence of arsenic. A solution of an alkaline phosphate, which yields a yellow precipitate with nitrate of silver, is not affected by the ammonio-nitrate when properly made; and conversely, a solution of arsenious acid gives only a faint turbidness with nitrate of silver, while it is copiously precipitated of a yellow colour by the ammonio-nitrate. Medical jurists appear to have overlooked the fact, that a solution of phosphoric acid is precipitated by this test, exactly like a solution of arsenic: but the answer to any objection on this ground, is that pure phosphoric acid either gives no precipitate or one of a pale blue colour, with the ammonio-sulphate of copper,—that it is not affected by sulphuretted hydrogen gas, and lastly, that on boiling copper in the acid liquid, and adding muriatic acid, there is no deposit of arsenic on that metal. Phosphorus, it must be remembered, may contain arsenic, and thus contaminate the preparations into which it enters. See case, Med. Gaz. xxxv. 655.

No one, in the present day, would think of employing these liquid tests in solutions, in which the arsenic was mixed with organic matter. Almost all liquids used as articles of food are precipitated or coloured by one or both of them, somewhat like a solution of arsenic, although none of that poison be present. Thus, then, any evidence founded on their employment, unless the arsenic be dissolved in pure water, or unless the precipitates yield the poison, should be rejected. On the whole, these liquid tests appear to me to be useful, rather as adjuncts to other processes, than as a direct means of detecting arsenic. An exclusive reliance upon them has led to the rejection of che-

mical evidence on several trials, where they had been most improperly employed in the analysis of suspected liquids containing organic matter. The trial of *Donnall* at Launceston, in 1817, affords a memorable lesson to the medical jurist on that subject.

Sulphuretted hydrogen gas.—The hydro-sulphuret of ammonia gives no precipitate in a solution of arsenic until an acid has been added, whereby arsenic is known from most metallic poisons. On adding an acid (acetic) a rich golden yellow-coloured precipitate is thrown down (orpiment or sesqui-sulphuret of arsenic.) It is better, however, to employ in medico-legal analysis, a current of washed sulphuretted hydrogen gas, which is easily procured by gently heating the sulphuret of iron in diluted sulphuric acid. The arsenical liquid should be slightly acidulated with acetic or very diluted muriatic acid, before the gas is passed into it. The yellow compound is immediately produced if arsenic be present, and may be collected by boiling the liquid to drive off any surplus gas. The precipitation is likewise facilitated by adding to the liquid a solution of muriate of ammonia. This yellow precipitate is known to be sesquisulphuret of arsenic by the following properties:—1. It is insoluble in water and alcohol, as well as in all acids mineral (muriatic) and vegetable; but it is decomposed by strong nitric, and nitro-muriatic acids. 2. It is immediately dissolved by caustic potash, soda, or ammonia, forming a nearly colourless solution. 3. When dried and heated with three parts of soda-flux, or, what is better, an equal part of cyanide of potassium, it furnishes a metallic sublimate of arsenic. This last experiment requires a little care, as some sulphur is apt to be sublimed, and obscure the results. If fine pulverulent silver be used as the reducing agent and heat *gently* applied, the arsenic is evolved at once from the sulphuret in a ring of octohedral crystals of arsenious acid. Unless these properties are proved to exist in the yellow precipitate formed by sulphuretted hydrogen in an unknown liquid, it cannot be a compound of arsenic; and it would not be safe to receive evidence on the point. On the other hand, when these properties are possessed by the precipitate, it must be arsenic, and can be no other substance. This test is extremely delicate in its reaction. It begins to give a yellow tinge when the liquid contains only the 4,000th part of a grain of arsenious acid in ten drops of water, the arsenic therefore forming about the 40,000th part of the solution.

Objections to the gaseous test.—Many objections have been taken on criminal trials to the medical evidence, founded on the application of this most valuable test. 1. *Cadmium.* It is remarkable that this metal should furnish, at the same time, a plausible ground of objection, both to the process by reduction from the solid state, and to the gaseous test applied to a solution of the poison. Thus the soluble salts of cadmium yield, with sulphuretted hydrogen, a rich yellow precipitate resembling closely that produced by arsenic, and this also gives a metallic sublimate when heated with soda-flux. There are, however, these striking differences;—the yellow compound of arsenic is solubie in ammonia, that of cadmium is insoluble,—the compound of arsenic is insoluble in strong muriatic acid, that of cadmium is perfectly soluble. Of the dried precipitates, the sulphuret of arsenic is not affected by strong muriatic acid, even on boiling,—that of cadmium is dissolved readily with the evolution of sulphuretted hydrogen gas; and a salt of cadmium is thereby formed, precipitable as a white carbonate by alkaline carbonates. A solution of a salt of cadmium is immediately thrown down, of a rich rellow colour, by hydro-sulphuret of ammonia,—that of arsenic is not precipitated by this agent. There are many other differences: thus cadmium is not precipitated on copper like arsenic, when boiled with muriatic acid, and it does not combine with hydrogen to form a combustible gas. An objection on the ground of the strong similarity of cadmium to arsenic, was unsuccessfully taken, to the chemical evidence given on the trial of *Mrs. Burdock* at Bristol, in 1835. 2. *Tin.* A persalt of tin is precipitated of a dusky yellow colour by the gas; but the precipitate is destitute of all the properties of sulphuret of arsenic; it is insoluble in ammonia, and it gives no metallic sublimate when heated with flux. A solution of tin is also known from one of arsenic, by its being in-

stantly precipitated by the hydrosulphuret of ammonia. 3. Antimony. A solution of this metal is precipitated of a rich orange red (not yellow) by the gas,—the precipitate yields no metallic sublimate with flux, and the solution of antimony is also precipitated by hydrosulphuret of ammonia.

It is customary for toxicologists, to lay down the rule that the objection urged against one test for arsenic is removed by the application of the other tests. In a criminal case in which I had lately to give evidence (*Reg. v. Jennings*, Berks Lent. Ass. 1845,) it was ingeniously urged in the defence, that there might perchance be such a mixture of substances not containing arsenic, as to affect all the tests like arsenic when separately applied. This, however, is clearly a chemical impossibility. A mere change of colour, or even the production of a precipitate on adding a test to an unknown liquid, furnishes no evidence, unless the properties of the precipitate be those of an arsenical compound. Again, no conceivable mixture of substances would produce a metallic ring resembling that of arsenic, so as to deceive one experienced in such matters; and far less a ring, possessing those properties of an arsenical sublimate, which it would be easy for one who may have had but little experience, to determine by simple chemical processes.

MARSH'S PROCESS. HYDROGEN TEST.—The action of this test depends on the decomposition of arsenic and its soluble compounds, by hydrogen evolved in the nascent state from the action of diluted sulphuric acid on zinc. The apparatus is of the most simple kind, and is so well known as to need no description. The arsenic may be introduced into the short leg of the tube, in the state of powder; but it is far better to dissolve it in water, by boiling, either with or without the addition of a few drops of caustic potash. The metallic arsenic combines with the hydrogen, forming arsenuretted hydrogen gas, which possesses the following properties. 1. It burns with a blueish white flame, and thick white smoke (arsenious acid). 2. A cold plate of glass or white porcelain held in the flame near the point, receives a dark stain from the deposit of arsenic upon it. This stain is composed in the centre of pure metallic arsenic, which may be sometimes raised up in a distinctly bright leaf of metal,—immediately on the outside of this, is an opake black ring, (suboxide or hydruret of arsenic), which, when viewed by transmitted light, is of a clear hair-brown colour at the extreme edge:—if the quantity of arsenic be very small, the metallic lustre and opacity may be wanting, and the whole stain will have this colour by transmitted light. On the outside of this black ring, is a thin wide film of a milk-white appearance, which is nothing more than arsenious acid reproduced by combustion. 3. A white saucer or a slip of card or paper moistened with ammonio-nitrate of silver, held about an inch above the flame, will be found, if arsenic be present, to be coloured yellow, from the reproduced arsenious acid in vapour being absorbed, and forming yellow arsenite of silver, easily soluble in acetic acid and ammonia. Unless the gas possess these properties, there is no certain evidence of the presence of arsenic in the liquid examined.

This process is probably the most delicate of all those which have been devised for the detection of arsenic, but it requires the greatest care in its application. Its delicacy has been sometimes improperly estimated by the assumed weight of the metallic deposit on glass; whereas it is probable that the quantity of arsenic in one infinitesimal deposit, if transferred to the apparatus, would give no indication whatever of the presence of the poison. In this process it must be remembered that in operating on the poison we are dividing and subdividing the metal into a series of deposits, the weight of some of which might not be equal to the millionth part of the weight of the arsenic which is actually furnishing them.

Objections to Marsh's test.—Other substances will combine with nascent hydrogen, and when that gas is burnt, a deposit will be formed on glass which may be mistaken for arsenic. Late researches have shown, that a liquid containing antimony, tellurium, selenium, iodine, bromine, phosphorus and sulphur, or some kinds of organic matter, may in this way produce an inflammable gas, and leave a deposit on glass. The only objection

of any practical force is that founded on the presence of antimony. There are these differences between the arsenical and antimonial stains; the stain of antimony has not the bright metallic lustre which that of arsenic sometimes presents; by transmitted light it is of a smoky black, while that of arsenic is of a hair-brown colour. Although the antimonial is very similar in colour to the arsenical flame, yet the third property is entirely wanting. If the ammonio-nitrate of silver be held over the antimonial flame, the silver is reduced; no yellow arsenite is formed, as in the case of arsenic. This last criterion distinguishes the arsenical flame from that produced by all the other bodies above mentioned. It has been recommended to apply tests to the stains themselves, but fallacies are liable to occur in operating upon such minute films. It is far better in case of a doubt, to apply some other process to the analysis of a part of the original liquid.

But, secondly, the sublimate may be proved to be arsenical, and yet it may be fairly alleged that the arsenic was derived from other sources, and not from the suspected liquid. Zinc and sulphuric acid, which are employed in the experiment, are often impure. Dr. Clark, of Aberdeen, informs me that he has not discovered a specimen of zinc free from arsenic, when about an ounce of the metal was used in an experiment, and the hydrogen gas evolved was tested by a solution of nitrate of silver. Sulphuric acid has been found to contain either arsenic or selenium; the latter substance yields a brown deposit; but in every other respect it differs from arsenic. The sulphuric acid of commerce sometimes contains a large quantity of arsenic. Mr. Scanlan found that 2000 grains of one specimen of acid yielded 1·5 grains of sesquisulphuret of arsenic. (Pharm. Jour. Aug. 1844.) I lately met with a specimen so impregnated with arsenic as to render it dangerous for use in the preparation of hydrogen. Arsenic may be easily detected in the impure acid by Reinsch's process. The best answer to all objections of this kind is, that the materials should be tried repeatedly, before the suspected liquid is introduced into the apparatus. If no sublimate be formed until after the introduction of the suspected liquid, it is evident that the arsenic must be in the liquid introduced; a fact which may be considered as clearly established, if, on removing the liquid and washing out the tube, no stains whatever result from employing portions of the same sulphuric acid and zinc. In using this test, fresh zinc should be employed for each experiment; and the apparatus should be thoroughly cleansed before use. Dr. Geoghehan has found that arsenic is liable to be deposited on zinc by standing, probably from a partial decomposition of the arsenuretted hydrogen gas; and I have observed that the same deposit is apt to take place in the fine tube connected with the stop-cock.

These are, I believe, the only tangible objections to the use of Marsh's test, and they are not difficult of removal, where moderate care is taken. It will be apparent, that not one of these objections could apply, except to those cases where Marsh's test is relied on, as the sole and exclusive chemical proof of the presence of arsenic; but in most instances where this test is safely applicable, other tests are also applicable; and it does not at all diminish the merit of this most useful and ingenious discovery, to say that the results which it furnishes, should be corroborated by the use of some of the other tests, if it were only for the sake of preventing any plausible objections to the inference derivable from its use. The great object of chemical evidence is not to show a Court of law what may be done by the use of *one* test only, but to render the proof of the presence of poison most clear and convincing. If, in any case, we have no other evidence to offer, but that furnished by Marsh's test,—a case in which the quantity of poison must be infinitesimal, and the metallic deposits proportionably minute,—then it would be better to abandon the evidence altogether, than to maintain that poison is present from results which admit of no sort of corroboration; for all who have experimented on the subject, must perceive the utter inefficacy of applying liquid tests to determine the chemical properties of imponderable and scarcely visible sublimates. This appears to me to have been the most

objectionable part of the evidence in the well-known case of *Madame Laffarge* (1840.) Orfila admitted that he had obtained only a few deposits so slight that they could not be weighed. He estimated the united weight at half a milligramme, or about one thirteenth of a grain. It was owing to too great a confidence in the extreme application of this test, that arsenic was pronounced to be a natural constituent of the human body, existing especially in the bones and also probably in the muscular system; owing to the same cause, it was said to have been found in the loose soil of cemeteries, and rules were given to distinguish *normal arsenic* from that taken as a poison! The experiments of many English chemists, as well as those lately performed before the Academy in France by M. Orfila himself, have shown that arsenic does not naturally exist in the body; and that there must have been some undiscovered fallacy in his previous experiments.

The following is an extract from the Report published by Orfila. "*Expériences pour rechercher l'arsenic dans le corps de l'homme a l'état normal.*" Dans douze expériences faites par les commissaires avec la chair musculaire, avec des os plus ou moins calcinés et traités tantot par l'acide chlorhydrique a l'air libre ou en vaisseaux clos, et avec du bouillon de bœuf on n'a jamais obtenu d'arsenic (arsenic normal.) Rapport de l'Académie Royale de Médecine, &c. Par M. Orfila, 1841, p. 45.

It is singular how long an error in Medical jurisprudence, when once diffused, will continue to find circulation, although the experiments upon which it was based, may have been long since refuted. The refutation of Orfila's opinion that arsenic existed as a natural constituent of bone, took place in 1841; but no case of poisoning by arsenic now comes to trial in which the most ingenious objections founded upon his first experiments, are not urged to the chemical evidence of the presence of the poison. Rightly or wrongly, applicable or inapplicable, they are invariably raised by a counsel in defence. In one case, in which I was lately called upon to give evidence where about five grains of solid arsenic were found lying on the mucous membrane of the stomach, Orfila's view that arsenic was a natural constituent of the tissues, was opposed to the chemical evidence. The inapplicability of the objection in that case, was immediately made evident by the judge asking the question, whether it was possible for a human being to generate spontaneously in the cavity of his stomach, five grains of solid arsenic! In the case of *Gilmour*, (Edinburgh, Jan. 1844,) &c., Dr., Christison very properly said, in answer to an objection taken to his evidence on the detection of arsenic in the liver, "that it was no constituent part of the human body, and was not formed in it. The individual (Orfila) who first promulgated this theory only argues now that small quantities are found in the bones, but in three several experiments before the Academy in Paris, he was unable to show it." Notwithstanding this clear disproof, the case of the *Queen v. Port* (ante, p. 124) shows that our judges are inclined to allow of its existence, because in that case, as must necessarily happen with respect to absorbed arsenic, the quantity of poison detected was *small!*

Many modifications of Marsh's test have been proposed. Thus MM., Danger and Flandin burn the gas in connexion with a cooled receiver, so that a solution of arsenic is thereby obtained. They make it the medium for extracting arsenic in a state fitted for testing. M. Lassaigne and Dr. Clark cause the arsenuretted hydrogen to pass into a solution of nitrate of silver, whereby arsenious acid (Lassaigne) is obtained in solution, and arsenuret of silver is precipitated. (Clark.) Berzelius, Liebig, and Köppelin and Kampmann, conduct the arsenuretted hydrogen through a tube instead of burning it; and the two latter chemists dry the gas by making it pass over fused chloride of calcium. The tube is then heated, and a clear ring of metallic arsenic becomes deposited at a little distance from the point to which the heat is applied. This result depends on the fact that arsenuretted hydrogen is easily decomposed, and its arsenic is separated at a moderate heat. All other metals which combine with hydrogen, are deposited in the spot which is heated; and do not, like arsenic, form a well-defined ring in front of it.

Mr. Morton proposes to produce the hydrogen by the galvanic decomposition of water, instead of by the action of sulphuric acid and water on zinc. In this way it is expected that we should get rid of all the objections to the presence of arsenic or other impurities in the materials employed, the hydrogen evolved in this case being absolutely pure.

Since the first edition of this work other modifications of Marsh's process have been proposed. Mr. Ellis has advised that the arsenuretted hydrogen instead of being burnt should be decomposed by passing it over the dried oxide of copper,—the gas is absorbed without the aid of heat, and water, and probably arsenite of copper result. Arsenious acid is then obtained by heating the oxide of copper in a tube. A new apparatus has been recommended by Berzelius, the object of which is to remove the froth and facilitate the collection of arsenic in the metallic state. (Chem. Gazette, 1845, p. 47.) From my own experiments, I cannot speak very favourably of this apparatus. There are more inconveniences attending its use, than are met with in the original apparatus of Marsh.

Reinsch's process.—In the application of this ingenious process, the solid or liquid suspected to contain arsenic, is boiled with about one-eighth part of pure muriatic acid, and a slip of bright copper foil is introduced. If arsenic be present even in small quantity, the copper acquires either immediately or within a few minutes an iron-grey coating from the deposit of that metal. This is apt to scale off, if the arsenic be in large quantity or if the liquid be long boiled. We remove the slip of copper, wash it in water, dry it and gradually heat it in a reduction tube, when arsenious acid will be sublimed in minute octohedral crystals: if these should not be apparent from one piece of copper, several may be successively introduced. Or what is more convenient, a large surface of copper may be at once covered—the grey deposit scraped off and the powder gently heated in a reduction tube. This test succeeds perfectly with powdered arsenic, the arsenites, arsenic acid, the arseniates and orpiment. It will even separate the arsenic from the arsenite of copper and from common lead-shot. When the quantity of arsenic is small, the copper acquires a faint violet or blue tint, and the deposit is materially affected by the quantity of water present, or, in other words, the degree of dilution. But one great advantage is, that we are not obliged to dilute the liquid in the experiment, and there is no loss of arsenic except as it may be removed by the introduction of successive portions of copper. This process is extremely delicate, the results are very speedily obtained and are highly satisfactory. One caution is to be observed, i. e. not to remove the copper from the liquid too soon. When the arsenic is in minute quantity, the deposit does not take place sometimes for half an hour.

Certain *objections* have been urged to this test. Thus arsenic may be present in the muriatic acid: this is at once answered by boiling the copper in a portion of the muriatic acid before adding the suspected liquid. A more important objection is, that other metals are liable to be deposited on copper under similar circumstances. Thus this is the case with antimony, whether in the state of chloride or of tartar emetic; nor is it always possible to distinguish by the appearance, the antimonial from the arsenical deposit. Should the quantity of antimony be small, the deposit is of a violet tint; if large, of an iron grey colour exactly like arsenic. Tin and lead become tarnished under the same circumstances, but there is no decided metallic deposit. Bismuth produces a deposit very closely resembling that of arsenic. With respect to mercury and silver, a metallic deposit takes place in each case without boiling. In a salt of nickel or cadmium, the copper undergoes no change; hence this is another important distinction between cadmium and arsenic. Lastly, if an alkaline sulphuret, or sulphuretted hydrogen be present in the liquid, the surface of the copper will become tarnished; but this effect takes place on contact without boiling, and without rendering the addition of muriatic acid necessary.

There is one answer to all of these objections, namely, that from the arsenical deposit, octohedral crystals of arsenious acid may be procured by *slowly*

heatlng the slip of copper or the grey deposit scraped from it in a reduction tube. If a very wide test-tube be used for this experiment, a ring of white arsenious acid will be obtained; this may be boiled in a few drops of water and tested by the ammonio-nitrate of silver and sulphuretted hydrogen. This corroboration is necessary because the crystalline form of arsenious acid is not always distinguishable, and the antimonial deposit gives a white amorphous sublimate, which however is quite insoluble in water. This facility of application renders it the more necessary for the experimentalist to be guarded in his inferences. It is not merely by the production of a stain on copper, that he judges of the presence of arsenic, but by the reconversion of the deposit, causing the stain, to arsenious acid, demonstrable by its crystalline form and other chemical properties. If a deposit take place on copper, but arsenious acid cannot be obtained by heating it, then the evidence of its having been caused by arsenic is defective. The larger the surface of copper presented in a small bulk, the greater will be the probability of arsenious acid being obtained. It was this which induced me two years since, to substitute for copper foil, the finest copper gauze or woven wire, containing sixteen thousand apertures to the square inch. The surface here presented is exceedingly great. After the deposit has taken place, the gauze should be pressed between folds of blotting paper, and then well dried above the flame of a lamp. It may now be rolled into a small compass and introduced into a reduction tube. To those who are not much accustomed to analysis, this plan may be more convenient than that of scraping the deposit from copper foil and heating the powder.

Of all the methods of detecting arsenic, there is none so simple, so speedy, or so easy of execution as this. Hence it has already in great part superseded most of the other more complex processes of testing for this poison.

Arsenic in liquids containing organic matter.—Arsenious acid, when in a state of solution, is not liable to be precipitated by any animal or vegetable principles, although all such substances render it less soluble in water. The liquid for analysis should be filtered through muslin, cotton, or paper, in order to separate any insoluble matters. Should it be coloured, this is of little moment, provided it be clear. If viscid, it should be diluted with water and boiled with a small quantity of muriatic acid; on standing, a deposit may take place, and this should be separated by a filter. As a trial test, we may now boil in a portion of the liquid, strongly acidulated with pure muriatic acid, a slip of bright copper In a few seconds, if arsenic be present, this will acquire a grey metallic coating. If after half an hour the copper remain unchanged, the arsenic, if present, must be in extremely minute proportion; if, on the other hand, the copper be covered by a grey deposit, it should be dried and heated in a reduction tube in the way already described (Reinsch's test,) in order to obtain from it, octohedral crystals of arsenious acid. From several such slips of copper, or copper gauze, a quantity of metallic arsenic may be procured, sufficient, on reconversion to arsenious acid, to allow of a solution in water being made, to which all the liquid tests may be applied. In this way, the 144th part of a grain of arsenious acid was detected in two fluid drachms of gruel, milk, porter, and other organic liquids, in so many different experiments. It has also been thus easily separated from wine, brandy, and the liquid contents of the stomach of a person poisoned by arsenic. Here our analysis might be closed, if the object were to determine only the *presence* of arsenic, since a case can rarely occur in medico-legal practice, where it would be necessary to extract the whole of the poison from the fluid contents of the stomach.

The process hitherto pursued for procuring evidence of the presence of this poison in liquids, has consisted in transforming the arsenious acid to the state of sesquisulphuret, and decomposing this compound by an alkaline flux. As a trial test, we may first dip a piece of white filtering paper into the suspected liquid, and expose it to the action of a current of sulphuretted hydrogen gas in a tube. If arsenic be present, the paper will acquire a rich yellow colour, which immediately disappears on dipping it into a

solution of ammonia. If the quantity of arsenic thus taken up by the paper, be less than the 4000th part of a grain, there will be no change of colour. We then test about half an ounce or an ounce of the liquid by passing the gas into it. If the liquid for analysis should contain oil, this may be separated after boiling, by passing it through a wet filter. Having satisfied ourselves that arsenic is present, we may get rid of a portion of the organic matter, by boiling the liquid with muriatic or acetic acid and filtering. This object may be further accomplished by adding to the liquid when cold, one-third of its bulk of alcohol, again filtering and separating the alcohol by distillation. Sulphuretted hydrogen gas may now be freely passed into the liquid acidulated with either of the acids mentioned. When all further precipitation ceases, the liquid should be filtered, the precipitate collected, dissolved in ammonia, and reprecipitated by an acid. By digesting it in water, alcohol, and muriatic acid successively, it may be deprived of any organic matter combined with it, sufficiently to allow of its reduction by soda-flux or metallic silver in the way described. The sulphuret has sometimes a dark brown colour from adhering organic matter, it is then better to transform it to arsenic acid by boiling it in nitromuriatic acid,—during which process, the organic matter is entirely destroyed, and a solution of arsenic acid is obtained and rendered fitted for testing, by digesting the evaporated residue in distilled water ; or the sulphuret may be deflagrated with nitre, and arseniate of potash then obtained. In this case the surplus nitric acid should be driven off by sulphuric acid. An abundant deposit of metallic arsenic is procured by boiling the liquid, in either case, with muriatic acid and copper gauze. In this way it is easy to analyse wine, coffee, tea, milk, porter, brandy and similar liquids, for arsenic.

The *contents of the stomach* often contain lumps of arsenic which may be separated by throwing those portions that do not pass through a filter into a large glass of distilled water, and after giving to it a circular motion, suddenly pouring off the supernatant liquid, when the heavy portions containing arsenic will be found at the bottom. The lumps may sometimes be felt in the contents : they may then be easily removed, dried on filtering paper and tested. If the arsenic has been taken in fine powder, there will be no lumps, but it will probably be deposited in masses, mixed with mucus and blood, on the coats of the organ in those parts where it is much inflamed and ulcerated. The arsenic in this state looks like moistened plaster of Paris, but is of a darker colour. It may be removed on a spatula, spread in masses on filtering paper and slowly dried. As it dries, the granules will detach themselves from the mass, and they may be then easily tested either by the reduction or by Reinsch's process — i. e. by boiling the suspected particles or even the stained portions of paper on which the organic matter has become dried, with muriatic acid and copper gauze. Mucus, blood, or even a layer of the mucous membrane of the stomach, may be thus easily tested.

This is in general the only process which it is now necessary to employ. By the use of numerous tests and processes, a witness only exposes his evidence most unnecessarily to many ingenious objections. In six cases of poisoning by arsenic which have occurred during the present year (1845) the poison was detected by the above plan,—the deposit on copper was converted by heat to arsenious acid,—this was dissolved in water, and the silver, copper, and sulphuretted hydrogen tests applied to the solution with the usual results.

Care must be taken not to confound pieces of bread or lumps of fat with arsenic. Small portions of such substances appear very much like lumps of the poison. Fat is detected by laying it on a piece of white filtering paper and passing beneath it a hot spatula—the fat melts and is absorbed by the paper : if the mass be arsenic, it will become simply dried.

In this way we avoid the troublesome and complex method of separating arsenic from organic liquids. The fact that the liquid contents yield no arsenic, must not lead us to suppose that the poison is absent. I have found solid arsenic spread over the coats of the stomach in two cases, when the liquid contents yielded no traces of the poison in solution. In the same way

I have detected no arsenic dissolved in tea when it was abundant in the sediment. (*Queen* v. *Lever*, 1845.) If none should be found either dissolved in the contents of the stomach or on the surface of the organ, we must cut off the inflamed and ulcerated portions of the mucous coat, and boil them with muriatic acid and copper for half an hour. The liquid may be then filtered and tested. It often happens that no arsenic is detected in the contents of the stomach or vomited matters, until after they have been boiled for one or two hours.

The value of the chemical evidence does not depend on the discovery of any particular *quantity* of poison in the stomach,—it is only necessary that the evidence of its presence should be clear and satisfactory. In the case of *Margaret Wishart*, Dr. Christison did not detect more than one-fortieth of a grain of arsenic in the coats of the stomach; but this was deemed sufficient chemical evidence, and the prisoner was condemned and executed. (Ed. M. & S. J., xxvi. 23.) Nevertheless there is a strong prejudice among lawyers that the chemical evidence is defective unless the quantity found be sufficient to cause death. (See antè, p. 57.) In the celebrated case of *Madame Laffarge*, Orfila's evidence was strongly objected to on this ground. He admitted that the quantity which he obtained from the body of the deceased was too small to be weighed, but estimated it roughly at half a milligramme, i. e. about the thirteenth part of a grain.

It is an important medico-legal fact, that in many undoubted instances of arsenical poisoning, not a trace of the poison can be found in the stomach or its contents. Several of these cases have occurred to my knowledge. In one, a girl took an ounce of the poison, and died in seventeen hours: there was much vomiting and purging, and the stomach-pump was used,—facts that might sufficiently account for the non-detection of poison in the body. In a second, nearly two ounces of arsenic were swallowed, and the person died in eight hours. No arsenic was discovered in the stomach. Even where there has been no vomiting and purging, the poison is not always found, but then the dose is generally small. Thus, in the case referred to me by Mr. Veasey, no arsenic could be detected in the stomach, duodenum, or their contents, although the patient had neither vomiting nor purging. Reasons have been already assigned for the non-discovery of the poison. (See ante. p. 54.)

Detection of absorbed arsenic in the tissues.—In order to provide a remedy for the difficulty above mentioned, and to furnish chemical evidence where it must otherwise fail, Orfila and others have proposed methods for extracting the arsenic *absorbed*, from the blood, secretions and viscera of the deceased. Orfila simply dries the animal matter and adopts the old process of incineration with nitre,—sulphuric acid is afterwards added to the lixivium, and the sulphate of potash produced is separated by crystallisation from the more soluble arseniate of that alkali, which is one of the products of incineration if arsenic be present in the animal matter. The arseniate formed may be then analysed by Marsh's apparatus, but it would be preferable to employ Reinsch's process. In this way Orfila has detected arsenic in the blood, urine and all the soft organs of poisoned subjects; but it appears that he was never able to discover the poison in less than eight ounces of blood and a larger proportion of muscular fibre; and he speaks of the occasional necessity of drying and incinerating the whole body! I have examined in this way four ounces of blood taken from one subject by two processes;—and the whole of the duodenum and part of the ileum of another,—both of whom had perished under the acute form of arsenical poisoning, but without any successful result.

MM. Danger and Flandin carbonize the animal matter by boiling it to dryness in a small quantity of strong sulphuric acid, about one-seventh part by weight. They digest the resulting carbonaceous ash in nitro-muriatic acid, and after driving off the acid by heat, treat the residue with distilled water. This yields arsenic acid, if arsenic were present in the viscera, a compound easily discovered by Marsh's or Reinsch's process. In pursuing this process, I obtained from seven ounces of the liver of a man poisoned by arsenic, about a dozen minute sublimates, as well as the action of the vapour

of the flame on ammonio-nitrate of silver. A full account of these processes will be found in the Traité de l'Arsenic of MM Danger and Flandin. Although the results thus obtained are open to many objections, yet one or other of the processes should be tried in all doubtful cases, where arsenic cannot be discovered in the body in the usual way. In the case of the *Queen* v. *Hunter*, tried at the Liverpool Spring Assizes, 1843, arsenic could not be detected in the contents of the viscera; and the judge suggested that the muscles or organs of the deceased should have been examined. This case shows that the detection of the absorbed arsenic must henceforth form a part of the duty of a medical jurist, when his other chemical experiments fail in discovering the poison. There is no doubt that evidence of this kind, when carefully obtained, will be received by a Court of law. In the case of the *Queen v. Thomas*, tried at the Cardiff Summer Assizes, 1843, no arsenic was found in the contents of the stomach and intestines of one of the deceased; but the poison was detected in the liver by incineration with nitre. This evidence, although attacked in cross-examination on the ground (now refuted) that arsenic was a natural constituent of the body, was received as a satisfactory proof of the presence of the poison. The plan advised by Dr. Christison, which is nothing more than Reinsch's process, is more easily applied than those above described. It is this. Cut the viscus into very small pieces and boil them in a mixture of one part of pure muriatic acid and ten of water for two hours, or until the whole of the organic matter becomes a soft magma. The liquid may then be strained, and the residue pressed. If the quantity of liquid be large, it may be concentrated by evaporation. The copper gauze or foil should be next introduced, and half an hour or an hour allowed for the deposit if necessary. Should a deposit be formed, its nature must be determined in the way already described. I have lately applied this process successfully to the detection of absorbed arsenic in the tissues in two cases of arsenical poisoning.

A witness in making use of this process must always be prepared to meet with the following objection—namely, whether a deposit resembling that of arsenic may not be formed on the surface of copper by long boiling with animal matter (free from poison) and muriatic acid. Having tried on several occasions the liquid contents of the human stomach, the viscera, and even common muscle, (beef), as well as various articles of food in order to determine this point,—the result has been, that except when arsenic was added,—or when there was a very strong suspicion of its presence, no deposit was formed on the copper. The metal came out of the vessel *untarnished*. It would be wrong, however, to say, whatever suspicions may exist, that arsenic was present in any case, unless arsenious acid was obtained from the deposit. The analyst should be aware that the liver, spleen and kidneys are the organs best fitted for yielding arsenic under these circumstances. The urine also contains it in the living and dead body.

When the poison is really present in the stomach at the time of death, it does not easily disappear, and may therefore be discovered for a long time after interment. White arsenic slowly becomes changed to yellow sesquisulphuret by the evolution of sulphuretted hydrogen in the decomposition of the stomach or its contents. It forms then a deep yellow stain on the surface, appearing like mustard. I have thus found it converted to sulphuret twenty-eight days after interment, (*Reg.* v. *Jennings*, Berks Lent Assizes, 1845:) but this change may take place in a shorter period. The conversion is in general only partial, as white grains may be often seen in the yellow mass. In *Mrs. Smith's* case, the sulphuret of arsenic was discovered in the stomach fourteen months after interment;—in another case, it has been detected at the end of three years, and in a third after seven years interment; (Med. Chir. Rev., April 1835;) but Wöhler is stated to have recently detected it in the bodies of two men *seven years and six months* after interment. This, however, was absorbed arsenic, and the process pursued was incineration of the soft organs by nitre. (Ann. der Chim. and Pharm. liii. 141. Chemical Gazette, 1845, 192. Med. Gaz. xxxv. 655.) I have ascertained that when the contents of the stomach are not allowed to drain away, the arsenic may be easily de-

tected after a very considerable period. A person died from the effects of arsenic on the 21st of February, 1834,—the poison was at the time easily found in the contents of the stomach; these have now been kept for upwards of *eleven* years loosely covered, and arsenic is still as readily to be detected in them as in the first instance, whether Marsh's or Reinsch's process, or sulphuretted hydrogen be employed.

Arsenic in solids.—Arsenic may exist in solid articles of food, such as bread;—it is also improperly introduced into the manufacture of some kinds of candles which may require analysis; and the matters vomited by a person poisoned, may sometimes be imbibed by articles of clothing or furniture. In all these cases we should simply boil the solid in water, with the addition of muriatic acid and copper; or to separate the whole of the poison we may proceed, as in the case of organic liquids, by using a current of sulphuretted hydrogen gas. A cat was poisoned with half a drachm of arsenic—the animal died in about nine hours. No trace of poison was found in the body; but a small part of the floor of the room where the cat had vomited, was scraped off, boiled in water, and yielded on analysis, clear evidence of the presence of arsenic.

Quantitative analysis.—The whole of the arsenic from a measured portion of the liquid must be precipitated by sulphuretted hydrogen, as sesquisulphuret. This should be purified by dissolving it in ammonia: it may be then washed, dried and weighed. Every *hundred* grains of sesquisulphuret obtained, indicate about *eighty* grains of white arsenic. The quantity may be also determined by multiplying the precipitate by 4, and dividing the product by 5. Should the sesquisulphuret be very impure, it may be converted to arsenic acid, and the proportion calculated by precipitating this as arseniate of silver. It has been recommended, in order to determine the quantity of arsenic contained in the tissues, to connect Marsh's apparatus with a horizontal glass tube, secured by a stop-cock, and dipping at a right angle into a solution of nitrate of silver. Heat being applied to the horizontal tube, the metallic arsenic is deposited in a succession of rings, and what escapes this deposition, is decomposed and collected by the nitrate of silver. The quantity of arsenic, is then estimated, and compared with the weight of organic matter employed. This plan is much too complex for general employment. It has been also stated that Reinsch's process would serve to indicate the quantity of arsenic; but this statement must have arisen from imperfect theoretical notions. If the copper be weighed before and after the deposit of arsenic upon it, the increase of weight in the latter case does not indicate the quantity of arsenic; because a portion of the copper is invariably lost as chloride,—a fact proved by adding ammonia to the liquid. If the copper be weighed with the arsenical deposit, and afterwards heated to expel the arsenic,—the loss of weight does not indicate the quantity of arsenic; because in being heated, the copper becomes partially oxidized—a fact apparent on inspection. The only satisfactory plan, therefore, to determine the quantity of poison, is to obtain the arsenic in the state of sesquisulphuret.

Arsenites.—The alkaline arsenites are all poisonous. One, the arsenite of potash, is well knowu under the name of Fowler's mineral solution, or Tasteless Ague Drop. One grain of arsenious acid is contained in 2·06 fluid drachms. (P. L.) The medicinal *dose* of this solution is from four to thirty minims twice a day. A case of poisoning by an alkaline arsenite is related by Orfila, i. 448. *Treatment.* Hydrated sesquioxide of iron. *Analysis.* The same as for arsenious acid.

Arsenic Acid.—This is an artificial product almost entirely confined to the chemical laboratory. Orfila states that it is a more powerful poison than arsenious acid, but he does not adduce any cases in support of this opinion. Dr. Christison does not mention it, and I have not been able to find any case of poisoning by it in the human subject. Dr. Glover ascertained that four grains of this acid, dissolved in two drachms of water and introduced into the stomach of a stout rabbit, killed the animal in four hours, with the symptoms of irritant poisoning, and an affection of the nervous system. (Ed. Med. and Surg. J., lviii. 121.) The arseniates are also poisonous. Dr.

Christison refers to two cases of poisoning by the arseniate of potash, (284), and Orfila states that seven horses were poisoned by this salt. (i. 452.) *Treatment.* The hydrated oxide or acetate of iron would be more likely to act as an antidote in poisoning by arsenic acid—owing to the greater solubility of this compound.

CHEMICAL ANALYSIS.—Arsenic acid is a white uncrystalline deliquescent solid. 1. It is not volatilized on platina foil, by the flame of a lamp. 2. It is very soluble in water, forming a highly acid solution. 3. It is precipitated of a dull red colour by nitrate or the ammonio-nitrate of silver. In all these characters it differs from arsenious acid. 4. It yields readily an arsenical sublimate with charcoal. 5. It yields abundant deposits with copper and muriatic acid, or in Marsh's apparatus. It is precipitated, though slowly and of a pale yellow colour, by sulphuretted hydrogen gas. In these properties, it resembles arsenious acid. The arseniates possess the same chemical characters as arsenic acid.

SULPHURETS OF ARSENIC. There are several kinds met with in commerce, *Orpiment* or *Yellow* arsenic, and *Realgar* or *Red* arsenic. They are very poisonous in consequence of their containing a large proportion of free arsenious acid, sometimes as much as 70 per cent of their weight. They are rarely used as poisons. Orpiment has, however, given occasion to two or three criminal trials in England.

CHEMICAL ANALYSIS.—The powdered sulphurets yield a solution of arsenious acid on boiling them in water acidulated with muriatic acid. They readily give the well-known sublimates of metallic arsenic, both with soda-flux, silver, and in the hydrogen apparatus. They also yield readily a deposit of arsenic when boiled with copper and muriatic acid. Orpiment is insoluble in muriatic acid, but is readily dissolved by caustic potash. *Organic Mixtures.* The sulphuret being insoluble in water, is in general easily separated mechanically by allowing the matters mixed with it to dry upon bibulous paper. If the sulphuret cannot be separated mechanically, the organic matter suspected to contain it, should be dried and boiled with nitro-muriatic acid to dryness. Any sulphuret will be found, as arsenic acid, soluble in water. Another impure sulphuret, sold as *King's yellow*, is composed, according to Dr. Christison, of sulphuret of arsenic, lime and sulphur. It is highly poisonous, and is extensively sold as a pigment. The sulphuret of arsenic is easily separated from it by digestion in caustic alkali. A medical jurist should be aware that orpiment has caused death by external application. (See case Ann, d'Hyg., 1834, 459.)

ARSENURETTED HYDROGEN.—This is a gaseous poison of arsenic, producing, when respired in small quantity, very serious effects upon the system. It has already occasioned death in three instances. This gas is an artificial product, and is formed in a chemical laboratory in various ways,—one method has already been described in speaking of Marsh's process, and its highly poisonous properties render it necessary that caution should be used in the employment of that mode of testing. The gas is most effectually decomposed, and prevented from diffusing itself by passing it into a solution of nitrate of silver. This form of gaseous arsenical poisoning has been hitherto purely accidental. Gehlen, a German chemist, was killed by accidentally breathing a small quantity: he was seized, an hour after respiring the gas, with vomiting, shivering, and great prostration of strength. He died on the ninth day. The most complete history of this kind of poisoning

has been published by Dr. O'Reilly of Dublin. He has been kind enough to forward me the particulars of one case.

A gentleman, for the sake of experiment, wished to respire about one hundred and fifty cubic inches of hydrogen gas. It unfortunately happened that the sulphuric acid, which he used for making the hydrogen, was largely contaminated with arsenic; and immediately after respiring the gas, he was seized with giddiness and fainting, constant vomiting of a greenish-coloured matter, and dull pain in the epigastrium. There was also complete suppression of urine. He died in about six days. On dissection, the liver and kidneys were found of a deep indigo colour,—the mucous membrane of the stomach was easily separated; and there were two distinct patches of inflammation in the greater curvature. There was a quantity of reddish-coloured fluid effused in the chest, and it is an interesting fact that Dr. O'Reilly, on examining about ten ounces of this fluid, was enabled by the use of Marsh's process to detect arsenic in it. From experiments made on the sulphuric acid, it is supposed that the deceased must have inhaled a quantity of arsenic equivalent to about twelve grains of arsenious acid.

The third case occurred in England, in December, 1836. A young gentleman was killed by respiring the gas, evolved from a mixture of arsenic, zinc and sulphuric acid. Death did not take place until twenty-four days after the accident. It appears that in this instance but a very small portion could have entered into the lungs.

CHAPTER XV.

ON POISONING BY MERCURY AND ITS COMPOUNDS.

METALLIC MERCURY, in the state of vapour, is well known to be pernicious to health, producing paralysis and other disorders of the system; but this is a form of poisoning which does not require medico-legal investigation. Liquid mercury appears to be entirely destitute of poisonous properties. Among numerous cases that are reported of this substance having been swallowed with impunity, may be mentioned one which was the subject of a report to the Westminster Medical Society in November, 1842. The individual in this case laboured under obstinate constipation which ended fatally. Five days before death, half a pound of fluid mercury had been swallowed as a remedial agent; no ill effects followed. On an inspection of the body, the mercury had wholly disappeared. The most important mercurial poison is *Corrosive sublimate*; but there are some other preparations of the metal, as calomel, the nitric oxide, and the acid nitrates of mercury, which have occasioned death.

CORROSIVE SUBLIMATE. (BICHLORIDE OF MERCURY.)—This substance is not often taken as a poison. In the coroner's report for 1837-8, there were about fifteen cases of mercurial poisoning, in twelve of which corrosive sublimate was the poison taken. This

substance is commonly seen under the form of very heavy crystalline masses, or of a white powder. Its *taste* is powerfully austere and metallic, so that no poisonous quantity of it can be easily swallowed without the individual becoming immediately aware of it. It is very *soluble* in water and speedily sinks in it, in which properties it differs strikingly from arsenic. I have found by experiment that one hundred parts of a cold saturated solution hold dissolved, six grains of corrosive sublimate; and it is stated by most chemists that two parts of boiling water (212°) will dissolve one part of the poison. It is also readily dissolved by alcohol and ether; the last body takes up one-third of its weight, and has the property of abstracting it from its aqueous solution, — a principle which may be sometimes advantageously resorted to for separating the poison when dissolved in organic liquids. It is soluble without change in nitric and muriatic acids, and it is a fact of some medico-legal importance, that common salt renders it much more soluble in water.

Symptoms. — The symptoms produced by corrosive sublimate, generally come on immediately or within a few minutes after the poison has been swallowed. In the first place, there is perceived a strong metallic taste in the mouth, often described as a coppery taste, and there is, during the act of swallowing, a sense of constriction and burning heat in the throat. In a few minutes violent pain is felt in the abdomen, especially in the region of the stomach, which is increased by pressure. Pain in the abdomen is, however, sometimes wholly absent. There is nausea, with frequent vomiting of long stringy masses of white mucus, mixed with blood; and this is accompanied by profuse diarrhea. The countenance is sometimes swollen and flushed, in other cases it has been pale and anxious. The pulse is small, frequent and irregular, becoming scarcely perceptible as the symptoms become aggravated. The tongue is white and shrivelled,— the skin is cold and clammy, the respiration difficult; and death is commonly preceded by syncope, convulsions, or general insensibility. The interior of the mouth when examined, sometimes presents the appearance as if it had been washed with a solution of nitrate of silver. Suppression of urine has also been noticed among the symptoms. This symptom was observed in a well-marked case of poisoning by this substance at Guy's Hospital. The patient lived four days, but did not pass any urine during the whole of that time. (G. H. R. April, 1844, p. 24.)

This poison differs from arsenic: 1, in having a well-marked taste; 2, in producing violent symptoms within a few minutes; and 3, in the fact of the evacuations being more frequently mixed with blood. The symptoms produced by corrosive sublimate, in the first instance, resemble those of cholera; if the individual should survive several days, they are more like those of dysentery,—tenesmus and mucous discharges mixed with blood being very frequently observed.

Mercurial preparations are well known to have a peculiar effect on the salivary glands, increasing the flow of saliva: but *salivation* is rather an uncertain and by no means a necessary symptom in cases of

acute poisoning by corrosive sublimate. In many instances, the patient dies too rapidly for this effect to follow, but even where he survives some days, salivation is not always observed. In a case related by Dr. Venables, where two drachms of the poison had been taken, and the woman survived eight days, this symptom did not exist. But in another, reported by Mr. Wood, (Ed. Med. and Sur. Jour. li. 114,) where half a tea-spoonful of the poison was taken, salivation was profuse in the course of a few hours; also, in a case which occurred at Guy's Hospital, in February 1843, where two drachms had been taken, salivation commenced in four hours: (see G. H. R, April 1844, p. 24,) but this is by no means the earliest period. Dr. Percy relates an interesting case of poisoning by corrosive sublimate, in which the saliva was flowing profusely an hour and a half after the woman had taken the dose, (thirty grains). (See Med. Gaz. 1843, i. 942.) In these early cases, it is alleged that fœtor of the breath is absent, but most practitioners will look chiefly to the production of salivation as a symptom. In the *chronic* form of poisoning, where the dose has been small and frequently repeated, we may generally expect to meet with this symptom, accompanied by fœtor of the breath and sponginess and ulceration of the gums. Should the person survive some time, salivation is more commonly met with than not; but in looking for it as an indication of mercurial poisoning, a medical jurist must remember, that some persons are wholly insusceptible of this condition. On the other hand, there are cases in which the salivary glands are most easily excited, so that the usual innocent doses of mercurial medicines, have been known to produce salivation to such a degree, as to cause death. Facts of this kind are of some importance, since charges of malapraxis may be easily raised in respect to them. Dr. Christison mentions a case in which two grains of calomel destroyed life by the severe salivation induced, as well as by ulceration of the throat. Another case was mentioned to me by a pupil, in 1839, in which five grains of calomel killed an adult by producing fatal salivation. From some cases related by Mr. Samuel of Newark, it appears that two grains of calomel divided into three powders, were given in the proportion of one powder daily, (two-thirds of a grain,) to a little boy aged eight. This small dose produced the most violent salivation, sloughing and exfoliation, from which he was some weeks in recovering. In another instance, a little girl aged five, took daily for three days, three grains of mercury and chalk powder. Her mouth was severely affected, sloughing ensued, and she died in eight days. In a third case, three grains of blue pill given twice a day for three days, making eighteen grains, were ordered for a girl aged nineteen, who complained of a slight pain in her abdomen. Severe salivation supervened, the teeth separated, and she died in twelve days. With respect to the effect of corrosive sublimate, Dr. Christison states that three grains of this substance in three doses, caused violent salivation. (408.) When this state results from the use of mild mercurial medicines in small doses, we must refer the effects to idiosyncrasy (antè. p. 11.) A person may die under

these circumstances:—either from simple exhaustion or from extensive sloughing of the fauces with exfoliation of the bones. When an individual has recovered from the first effects of acute poisoning by corrosive sublimate, he may die at almost any period from these secondary consequences.

It is generally admitted by toxicologists, that salivation may be intermittent, i. e. that it may cease and reappear without more mercurial poison, or any mercurial preparation being given in the interim, although such cases are rare. As a matter of medical jurisprudence, this important question was brought to an issue at the trial of *Butterfield,* at Croydon, in 1775. The deceased was supposed to have been killed by the administration of small doses of corrosive sublimate; and the fact of his having become salivated at or about the time of the alleged administration, was regarded as a proof of poisoning. In the defence, it was urged that the deceased had been salivated two months previously, under a common mercurial course,—and although the salivation had ceased for that period, it was probable that this was nothing more than a recurrence of the former:—it did not prove that there had been any fresh administration of mercury in the interim. There was a difference of opinion on this point among the witnesses, as there probably would be in the present day, if each relied upon his own individual experience. However, one of the witnesses had known salivation to recur without a fresh exhibition of mercury after the long interval of three months, and the prisoner was acquitted. Cases are reported of salivation recurring even after longer intervals than this.

Salivation is a symptom, not necessarily connected with the exhibition of mercury, and therefore when taken alone, it can never furnish evidence of mercurial poisoning. It may come on spontaneously from disease in the salivary organs. It may also be produced by many other substances besides the preparations of mercury. Thus it has been known to follow the use of the preparations of gold, copper, bismuth, lead, antimony, iodine, iodide of potassium, croton oil, opium, prussic acid, sulphuric acid, arsenic and foxglove. Some have asserted that fœtor of the breath, a brassy taste in the mouth, and spongy and ulcerated gums, would indicate the salivation caused by mercury: but these characters have been equally met with in the salivation produced by arsenic and bismuth. A very important investigation, involving the evidence of poisoning by mercury, as derived from salivation and fœtor of the breath took place at Nottingham in February, 1845, in the case of a girl named *Wilmot.* Although she suffered from symptoms of mercurial poisoning, the verdict returned was that she had died from disease of the brain.

Corrosive sublimate, as well as other mercurial preparations, is liable to produce *gangrene of the mouth* and fauces, a state which may equally occur from spontaneous causes: death is commonly the result. In a case of this kind, supposing any mercurial preparation to have been given medicinally, it may become a serious question whether death actually resulted from the mercury acting as a poison, or from natural

disease. Several fatal cases have occurred within the last few years, among young children; and the subject has become a matter of inquiry before coroners. Salivation and its sequelæ are said not to be common among young children, as an effect of mercurial preparations, except where there is idiosyncrasy; but notwithstanding this, it is clear, from the cases already recited, that small doses of mercury may have a most violent effect on young subjects, and render the suspicion of poisoning probable. Of two children, whose deaths became the subject of investigation, under these circumstances, one was affected with hooping-cough, and the other with measles. Powders containing calomel, were prescribed in both cases,—gangrene of the mouth followed, and the children died. There was some reason to believe, from the evidence, that the mercury had really produced the effect attributed to it, at least in one of the cases. It is proper to remark, that this kind of disease, gangrene of the mouth, has been observed to occur in children, to whom no calomel, nor any mercurial preparation whatever, had been exhibited:—the subjects have been chiefly young infants, badly fed and clothed, and generally labouring under, or recovering from, fever, small-pox, measles or hooping-cough. Many cases of this kind are reported by Dr. Hennis Green, (See Lancet, Dec. 1839,) and others. The disease has been often described under the name of "*Cancrum oris.*" A case occurred in August, 1840, in which a charge was made against a medical practitioner of having caused the death of a child, aged four years, by administering an overdose of some mercurial preparation. The child was labouring under hooping-cough, and some medicine was prescribed; on the fourth day, the child complained of soreness of the mouth, the teeth became loose and fell out, the tongue and cheek were very much swollen, and the child died in the course of a few days from gangrene in the left cheek. The answer to the charge was, that not a particle of mercury had been exhibited, a fact clearly proved by the production of the prescription-book of the medical attendant. This then was a case where the gangrene proceeded from spontaneous causes; and yet it is almost certain, that had any mercury been proved to exist in the medicine prescribed, a verdict affecting the character of the practitioner, would have been returned. In several instances, where but a small quantity of mercury had been exhibited, the disease and death were referred to it;—the cause appeared so obvious, that the general impression could not be shaken by the medical statement, that similar cases had occurred where no mercury was used. Sometimes the case may be of a doubtful nature. A boy aged three years, while suffering under an attack of measles, took small doses of mercury by the prescription of a physician. Soon after the administration of the medicine, the child became worse, the mouth became inflamed, dark and discoloured, and the teeth dropped out. He died in a few days. A practitioner who had been called in, pronounced that the child had been excessively salivated. Mercury had undoubtedly been taken, and it was proved, that the person who had dispensed the medicine, did

not weigh it. An inquest was held, and a verdict returned, that the child had died from an overdose of mercury. Mr. P. H. Holland of Manchester, has lately forwarded to me an interesting case of cancrum oris. The child, aged six years, had taken four grains of calomel in two doses with rhubarb. Swelling and sloughing of the salivary glands came on and the child died in ten days. The disease was not caused by the mercurial. Mr. Holland heard at the same time of six cases of excessive salivation in young children from common doses of calomel, almost indicating an influence of an epidemic character. See also an interesting case by Mr. Dunn, Med. Gaz. xxxiii. 57, and B. and F. Med. Rev., October, 1844, p. 542. It is worthy of remark, that in cases of this description, the popular opinion is generally supported by that of some medical practitioner, showing how easily members of the profession, as well as the public, are led to refer the effects to what in many instances is only an *apparent* cause. A child aged about four years, suffering from hooping-cough, took, according to a prescription obtained from a dispensary, three grains of calomel on the 29th of October: this dose was repeated five times between that date and the 7th of November following. About this time the right cheek became much swollen, and there was great difficulty in opening the mouth, with very offensive breath. The gums and inside of the cheek became ulcerated, and on the 16th a sphacelus appeared on the right cheek of the size of a shilling, which rapidly extended, and the child died on the 28th. This was considered to be a case of cancrum oris from spontaneous causes; but it would be difficult to say that the calomel had not here been the exciting cause. At any rate, it cannot be denied that there was reasonable ground for suspicion.

Are there any means of distinguishing gangrene as a result of disease, from the gangrene produced by mercury? A diagnosis has been founded on the allegation, that when the gangrene is caused by mercury, it is uniformly diffused over the gums, tongue and internal parts of the cheek; while, when of a spontaneous character, it is restricted to one patch or spot. This, however, is a very weak criterion. In a case recorded by Dr. Christison, where it resulted from mercury, the gangrene was observed to occur on the skin, near the mouth on each side: it thence spread over the whole of the cheek, and destroyed life in eight days. In general, however, it begins in the mouth or in the throat, and spreads onwards. Besides, it is quite possible that the spontaneous gangrene may present a diffused character. There is no certain diagnosis; at least, there are no general rules to guide a medical opinion: each case must be judged of by itself. The time of the occurrence of the symptoms, after taking the medicine, may be sometimes a good criterion; but this is not always applicable, for, by mere coincidence, the symptoms may supervene without being connected with the medicine. Then again, the symptoms may not have been caused, but only aggravated by the continued use of mercurials. The fact of the dose of calomel, or other preparation, having been small, is no obstacle to the admission of the view, that it has really caused the

gangrene; since cases have been already related, which show that in certain eonstitutions, small doses of mercury, have produced the most alarming and unexpected effects. Unless, then, a medical witness is prepared to assert, that no such idiosyncrasy could have existed in the case under investigation, it will be considered, when other facts concur, that the smallness of the dose, is no answer to the charge of the medicine having produced these serious consequences. It is also not improbable, that the diseases under which such subjects have been observed to labour, may aggravate the effects of mercury so administered, and render them more prone to this affection of the salivary organs.

POST-MORTEM APPEARANCES.—These, as in the case of arsenic, are chiefly confined to the alimentary canal. Corrosive sublimate, however, affects both the mouth and fauces; the mucous membrane is softened, and of a white or blueish grey colour; that lining the œsophagus, is similarly affected, and partially corroded and softened. The mucous membrane of the stomach is more or less inflamed, sometimes in patches; and there are masses of black extravasated blood found beneath it. Occasionally the whole cavity has a slate-grey colour from the partial decomposition of the poison by the membrane itself; beneath this the mucous coat may be found reddened. This grey tint of the mucous membrane has been considered by some to be indicative of the action of the poison on the living mucous membrane; but it is not always present. In a recent case at Guy's Hospital, the mucous membrane was simply inflamed, and very much resembled the condition presented in cases of arsenical poisoning. The coats of the stomach are sometimes corroded, and so much softened that they cannot be removed from the body without laceration. Similar appearances have been met with in the small intestines and rectum. Perforation of the stomach is very rare as an effect of this poison: there is, I believe, only one case on record. Certain morbid changes have been found in the urinary and circulating organs, but these are not by any means characteristic of this variety of poisoning. Appearances like those just described, have been seen, not only where the case has terminated fatally in a few hours, but where it has been protracted for six, eight, and even eleven days. For a minute account of the post-mortem appearances produced by this poison, see Chaussier Recueil de Mémoires, 363.

Cases of poisoning by the *external* application of corrosive sublimate are rare; it acts energetically through the unbroken skin, producing severe local and constitutional symptoms, and even death. Two fatal cases of this kind have been reported by Mr. Ward of Bodmin. (Med. Gaz. iii. 666.) A man aged twenty-four, rubbed over every part of his body, one ounce of corrosive sublimate, mixed with six ounces of hog's-lard, for the purpose of curing the itch. In an hour, he experienced excruciating pain in the abdomen and over the whole of his body;—he said he felt roasted alive,—he also suffered from intolerable thirst. The skin was found completely vesicated. He died on the eleventh day, having laboured under bloody vomiting, purging,

and tenesmus. Ptyalism did not show itself until thirty-six hours after the application of the poison. The brother of the deceased, aged nineteen, rubbed in the same quantity of the poison. The symptoms were much the same, but more aggravated. There was constant vomiting, with complete suppression of the urine, and frequent bloody stools; —the ptyalism was not so severe. He died on the fifth day. On inspection, the stomach was found much inflamed, and partially ulcerated. The small intestines were also greatly inflamed throughout; and the lower portion of the colon and rectum were in a state of mortification. The bladder was contracted, and without urine. Thirty large worms were found alive in the stomach and intestines. For another case, see Niemann Taschenb. der Arzneiw, 452. Death from the external application of corrosive sublimate has lately been the subject of a trial. There were the usual symptoms of irritation and the stomach and intestines were much inflamed. (*Reg.* v. *Welch*, Worcester Summer Assizes, 1845.) Med. Gaz. xxxvi. 608.

QUANTITY REQUIRED TO DESTROY LIFE.—This is a question which it is somewhat difficult to answer with any degree of certainty, since it is only by accident that the quantity taken can be ascertained, and the fatal effects must vary according to many circumstances. A child aged three years, died in twenty-three days from the effects of twelve grains of corrosive sublimate. The *smallest* dose which is reported to have destroyed life was *three* grains. This was also in the case of a child, and the quantity was accurately determined from the fact of its having been made up by mistake for three grains of calomel, which the physician intended to order. This case is referred to in the Lancet, 1835, p. 297. A very loose and imperfect report either of the same or a similar case is given in the Ann. D Hygiéne, 1835, i. 225. It is stated that three children lost their lives. It is probable that under favourable circumstances from three to five grains, or even less, would destroy an adult. In the case of *Reg.* v. *Robertshaw*, Carlisle Lent Assizes, 1845, there is reason to believe that two or not more than three grains were taken and proved fatal to an adult. (Med. Gaz. xxxv. 778.) In its power as a poison, it is therefore somewhat similar to arsenic. Persons have, however, been known to recover who have taken very large doses, where remedies were timely administered or vomiting was promoted. In an instance, reported in the Journal de Pharmacie, a man recovered in three days after having taken one drachm of the poison; in the Medical Gazette, (xiv. p. 63,) Dr. Booth mentions a case where *an ounce* of corrosive sublimate had been swallowed after a full meal; and by timely vomiting, the subject of this rash act escaped with comparative impunity. In Dr. Percy's case, (Med. Gaz. xxxi. 942,) a girl aged seventeen, mixed thirty grains in coarse powder with water in a teacup, and then swallowed the liquid. A considerable quantity remained in the cup. Symptoms of poisoning came on, but the girl recovered. The reporter doubted whether any of the poison reached the stomach. A most interesting case of recovery after *forty grains* had been taken in whiskey, under circumstances favourable to its

fatal operation, i. e. on an empty stomach, is recorded by Dr. Andrews. (Cormack's Journal, February, 1845, p. 102.) The patient was a wo, man of sixty-five. The actually smallest dose required to destroy an adult under ordinary circumstances, cannot therefore be determined at present from any reported facts. Judging from the effects produced by small quantities used medicinally, possibly the average fatal dose may not differ widely from that which I have above stated. Experiments on animals cannot settle this question,—observations on man must be purely accidental, and the cases that have yet occurred are not conclusive on the point. The doses either go beyond, or fall short of what may be fairly assigned as a possibly fatal dose. That one person has actually recovered after swallowing *forty grains* of this poison, does not show that twenty or thirty grains might be taken with impunity; although this absurd argument was used in respect to prussic acid by some of the medical defenders of Tawell! If true of one, it would be equally true of all poisons. In order to determine the minimum fatal dose of a poison, its known general effects, either medicinal or otherwise, must be taken into account, or a medical opinion will assuredly lead to error. It may be as well to mention here the price at which this poison is commonly sold to the public,—as the quantity taken is often stated in the evidence of non-professional witnesses by value. I am informed by a highly respectable retail house in London that from one to two drachms of corrosive sublimate are sold for twopence,—if exceeding this quantity, the price is sixpence per ounce.

PERIOD AT WHICH DEATH TAKES PLACE.—In an acute case, an individual commonly dies in from one to five days. But death may take place much sooner and much later than this. A person has been known to die from the effects of the poison in eleven hours, (Christison, 402,) and in one instance, of a child two years old, by whom twelve grains had been taken, death probably occurred in six hours. (Niemann's Taschenbuch, 451.) A case is reported in which a child, aged seven, was killed in three hours by eighteen grains of corrosive sublimate. The shortest case on record, although the period is only inferential, I believe to be the following, which occurred to Mr. Illingworth. (Med. Gaz. xxxi. p. 557.)

A man æt. 30, was found dead on the 4th December, 1842, at half-past seven A. M. He had vomited some half-digested food, mixed with blood and mucus. On a shelf near him was a drinking-horn, containing about three drachms of corrosive sublimate. It was ascertained at the inquest that he had died from the effects of this poison. He had put water into the drinking vessel, and had probably swallowed the poison while thus loosely suspended,—the exact quantity taken could not be ascertained. The deceased was last seen alive at half-past eleven the preceding evening; therefore only eight hours before he was found dead. When discovered, the face, as well as the extremities, were cold. From all the circumstances, it was inferred that even admitting the deceased to have taken the poison immediately after he was last seen alive, he could not have been dead for less than six hours. This would carry the duration of the case to *two hours* from the time of taking the poison. There is probably no instance in which the poison has acted with greater rapidity than in this.

Mr. Bigsley has published a case which proved fatal in two hours and a half; but the poison was a solution of the nitrate of mercury, not corrosive sublimate. On the other hand, the case may be protracted for several days: the following cases will not only shew this, but will also prove that the time at which the poison destroys life, cannot be inferred from the quantity taken. In one related by Dr. Venables, two drachms of the poison killed a woman in eight days,—and about the same quantity destroyed life in six days, in another that occurred to Mr. Watson of Edinburgh. In a third, reported by Sobernheim, three drachms did not kill for *eleven* days; while in an instance, referred to by Niemann, (Tasch d. Arzneyw, 452,) where one ounce of the poison was swallowed, the person did not die until the sixth day.

Treatment.—If vomiting do not already exist, it must be promoted by the exhibition of emetics. Various antidotes have been suggested for this poison; and among these, albumen both of the yolk and white of egg mixed with water, is perhaps the best fitted to counteract the effects of the poison. This remedy was proposed some time since by Taddei, an Italian chemist; and there are many instances of its efficacy on record. It appears to have had good effects, even when it was not taken, until some time after the poison had been swallowed. Different opinions have been entertained on the nature of the substance formed by the mixture of albumen with corrosive sublimate. Rose considers it to be a compound of albumen with peroxide of mercury; but after well washing I have found in it traces of corrosive sublimate. Its chemical nature is unimportant in respect to treatment. (B. and F., Med. Rev., Oct., 1844, 542.) Gluten has been also recommended:—it may be prepared by washing flour in a muslin bag, under a current of water. Should the case be urgent, the flour may be at once exhibited in the form of paste mixed with water. Gluten may often be obtained in this way, when albumen is not at hand. These remedies cannot be expected to be always successful: the sooner they are exhibited, the greater is the hope of success. Dr. Buckler, of Baltimore, relates the case of a young man who took about fifty-five grains of corrosive sublimate in a state of perfect solution; and albumen to the amount of a quart was afterwards administered, but nevertheless he died on the eighth day. In Dr. Andrews' case of recovery it was of doubtful benefit. Albumen was not administered for an hour and a half. The recovery was most probably due to early and copious vomiting. (Cormack's Journal, February, 1845.) Among other chemical antidotes the protochloride of tin in the proportion of one part to fifteen parts of water has been recently proposed by M. Poumet. Very favourable results have been obtained by experiments on animals, but its efficacy as an antidote in the human subject, still remains to be established. (Ann. D'Hyg. Juillet, 1845.)

In all cases, the entire expulsion of the poison from the stomach, should be looked to by the practitioner; and albumen or gluten may be given to aid the efforts of vomiting. The use of the stomach-pump is of questionable propriety; since if the parietes of the œsophagus and

stomach be softened and corroded, very slight force in its employment might lead to perforation.

Chemical analysis.—We will first suppose that the poison is in the *solid* state, and in the form of a white powder. 1. A small quantity heated on thin platina foil is entirely volatilized at a moderate heat,—(care should be taken in performing this experiment,)—in this property corrosive sublimate resembles arsenic, but it differs in all other respects. 2. It is very soluble in water,—if the water be warmed the powder will be dissolved instantly. 3. A small quantity of the powder dropped into a white saucer, containing a solution of iodide of potassium, is turned of a bright scarlet colour. 4. Dropped into potash in a similar way it is turned of a yellow colour. 5. Into a solution of hydrosulphuret of ammonia, it is turned black. 6. When a few grains are rubbed on a clean surface of copper, with a mixture of one part of muriatic acid, and two parts of water, a bright silvery stain is produced, which is entirely volatilized by heat. If zinc or tin-foil be used instead of copper, the surface acquires a silvery lustre, and the metal becomes remarkably brittle. 7. When mixed with three or four parts of calcined carbonate of soda and heated in a small tube similar to that employed in the analysis of arsenic, the metal is reduced; and a ring of bright globules of mercury is formed, while common salt remains in the tube. For the success of this experiment, the materials must be quite dry, and the tube at first gently heated; any undecomposed corrosive sublimate that may be sublimed, should be driven higher up, before finally applying a strong heat, so that the ring of mercury may not be obscured by it. This last experiment is conclusive of the nature of the substance, as mercury, being the only liquid metal, is the only metal which sublimes in globules. If the end of the reduction tube containing the fused chloride of sodium left as a residue in the decomposition be filed off, reduced to powder and boiled in water with a little nitric acid, a solution is obtained in which, on the addition of nitrate of silver, chlorine may be proved to exist. The analysis is then complete. The properties mentioned under 1, 2, and 5, are possessed in common by other bodies; but the other characters are peculiar to the persalts of mercury: and when the results agree, render it absolutely certain that the powder must be a persalt of that metal. The action of nitrate of silver upon the solution of the residue will prove that the salt must have been a *chloride*. There are therefore no *objections* to this mode of analysis. The experiment of reduction will answer with any visible quantity of the poison.

The *weight* of the metallic sublimate may be determined in the same way as that of arsenic, and it may be preserved in like manner, i. e. by hermetically sealing the tube. Another excellent reducing agent has been proposed by Dr. Frampton, namely, pulverulent metallic silver. Four parts of this should be used to one of corrosive sublimate. See Med. Gaz. xxxii. 384.

Corrosive sublimate in solution in water.—It is very soluble in water, (ante, p. 148,) forming a clear solution, which, when concentrated, has a faintly acid reaction and a strong metallic taste. A few drops of the solution may be first gently evaporated on a slip of glass, and then set aside to crystallize. If it be corrosive sublimate, it forms slender opake silky prisms, sometimes of considerable length and intersecting each other. When a solution of iodide of potassium is dropped on them, they acquire a bright scarlet colour, and chloride of potassium is formed. These characters, which may be obtained from one drop of solution, prove that the body dissolved in water, is corrosive sublimate; it is thus distinguished from every other mineral poison, and all other substances whatever.

Tests.—1. *Potash.* On adding a small quantity of caustic potash to the solution, a reddish coloured precipitate falls, becoming yellow by the addition of a larger quantity of alkali. This precipitate, when washed, dried and heated in a reduction tube, yields a well-defined ring of metallic mercury. The filtered liquid will be found, on being tested with nitrate of silver, to contain chloride of potassium, thus proving that the mercury was in the state of

bichloride,—this being the only chloride of that metal which is soluble in water. 2. *Protochloride of tin.* On adding this test in rather large quantity to the solution, a white precipitate at first falls down, (calomel,) becoming speedily of a slate-grey colour, and afterwards almost black. On warming the liquid, it soon becomes clear, while a heavy precipitate, in great part formed of pure metallic mercury, falls to the bottom of the vessel. The mercury may be collected by pouring the liquid on a filter, and afterwards warming the filter; or its presence may be easily demonstrated, by pouring the water carefully from the precipitate, and forcing down upon this a slip of bibulous paper;—this absorbs the water from the mercury, and the pressure condenses the metal into one or more well-defined globules. 3. *Sulphuretted hydrogen gas.* This gives at first a precipitate, partly black and partly white, (chlorosulphuret,) becoming entirely black, when the current of gas has been allowed to pass in for some time. *Hydrosulphuret of ammonia* gives a similar precipitate in the solution;—thus clearly distinguishing corrosive sublimate from arsenic. The precipitated black sulphuret of mercury, dried and heated with carbonate of soda or metallic silver, easily furnishes a ring of pure metallic mercury. 4. *Precipitation by metals.* If we acidulate the liquid with a few drops of diluted muriatic acid, and introduce a slip of bright copper, or what is better, fine copper gauze, it is soon coated with metallic mercury, having more or less of a silvery lustre, especially on friction. On heating the copper in a reduction tube, the mercury may be obtained in well-defined globules. If instead of copper, we employ finely powdered silver as recommended by Dr. Frampton, the results are more satisfactory, and a larger quantity of mercury, is procured in the sublimate. Pure tin or finely laminated zinc may be also usefully employed. While the zinc acquires a silvery whiteness, it becomes brittle, and when broken up and heated in a reduction tube, an abundant sublimate of metallic mercury is obtained. 5. *The galvanic test.* There are various ways in which galvanism may be applied to the detection of mercury in corrosive sublimate. Dr. Wollaston, on one occasion, employed an iron key and a guinea: he placed a drop of the suspected solution on a surface of gold and touched it and the gold with a key:—the mercury was deposited on the gold in a bright silvery stain. The following is a ready method of producing the metal. Place a few drops of the solution on a clean surface of copper, and slightly acidulate it with muriatic acid;—then touch the copper through the solution with a slip of zinc foil. Wherever the copper is touched by the zinc, the mercury is deposited, and on washing the surface with diluted muriatic acid a silvery stain is left, which is immediately dissipated by the heat of a spirit-lamp, thus proving it to have been derived from a volatile metal. This experiment may be modified by twisting a slip of zinc round a slip of bright copper, or copper gauze, and introducing them into the liquid. Mercury is deposited on both. A surface of gold with zinc foil is, perhaps, more delicate than a surface of copper as a test of the presence of mercury. Applied in a way to be presently explained, it will detect the metal when nearly every other method fails. Other tests have been proposed; but I omit all notice of them, because the foregoing are, in my opinion, quite sufficient for every practical purpose.

Objections.—Among the abovementioned tests, there is only one to which any objection can be offered, namely, 3. Sulphuretted hydrogen gas, or hydrosulphuret of ammonia. Either one or both of these re-agents will give a black or dark brown precipitate with several metals, as for example with the salts of lead, copper, bismuth, silver, nickel and some of the compounds of tin. The precipitate derived from mercury is, however, distinguished from all the others, by the fact that it yields that metal when dried and heated in a tube with carbonate of soda or metallic silver. Again the objection is at once answered by the fact, that the other tests are conclusive of the presence of a mercurial salt: it could only apply where the production of a black precipitate from sulphuretted hydrogen, was alone relied on as evidence of the presence of a mercurial salt.

In liquids containing organic matter.—The same process of analysis will also apply to the vomited matters and contents of the stomach. Masses of

corrosive sublimate may be sometimes locked up in thick viscid mucus, and in such cases, the powder being heavy, it may be sometimes separated by simply agitating the viscid liquid in water and then decanting it suddenly. This poison is decomposed and precipitated by many organic principles, such as albumen, fibrin, mucous membrane,—also by gluten, tannin and other vegetable substances. Thus then we cannot always expect to find it in a state of solution. We must filter in order to separate the liquid from the solid portion; and our first object will be to determine whether any of the poison is held in solution. If the liquid be clear, the protochloride of tin may be used as a trial test: if an abundant grey precipitate be formed,—the poison is probably present in large quantity. I have found occasionally useful as a trial test, the galvanic reduction of a portion of the liquid on copper foil, by means of zinc and a small quantity of diluted muriatic acid. Supposing that one or both of these tests give strong evidence of the presence of mercury dissolved, we may add to the liquid one-half of its bulk of ether in a bottle, and agitate the mixture. On allowing it to stand some time, the greater part of the ether will rise to the surface, holding dissolved the corrosive sublimate, which was contained in the organic liquid. This may be separated by decantation, by a funnel or pipette;—distilled in a retort, and the corrosive sublimate is thus recovered in a pure state. This process, which was first suggested by Dr. Christison, I have found to answer only where the corrosive sublimate was in moderately large proportion. If none should be thus procured, the following method will detect mercury, even when present in very small quantity; and this plan of course applies to all those cases, where the trial tests fail to give any satisfactory indications of its presence. Cut a slip of fine gold foil of about one inch in length and one-eighth of an inch in width; it should be just large enough to enter into a small reduction tube. We then twist round this, in a spiral form, a narrow slip of finely-laminated zinc; acidulate the suspected liquid with a few drops of diluted muriatic acid, and suspend the gold and zinc by a thread in the midst of it. Several such pieces may be at once suspended in the liquid. According to the quantity of mercury present, the gold will be coated of a grey colour, either immediately or in the course of a few hours. If at the end of five or six hours, the gold retains its bright yellow colour, there is probably no mercury present, or the quantity is too minute to be detected. Supposing the gold to have lost its colour, owing to its having become completely coated, we should remove it and dip it in ether and afterwards in distilled water, to wash off any corrosive sublimate and organic matter adhering to it: it should then be dried without being allowed to touch any surface, and introduced into a reduction tube. The zinc may be in part dissolved; but as mercury is also deposited on this metal, whereby it is commonly rendered quite brittle, it may be introduced with the gold into the tube. On applying heat, a fine sublimate will soon appear in the cool part of the tube, which, if not perceptible to the eye, may be easily seen by the aid of a common lens, to consist of minute globules of mercury. Slips of fine copper or copper gauze with or without zinc attached, or slips of pure laminated zinc alone, may also be employed as a substitute for gold; but in this case, after removing the metals, it is necessary, not only to wash in water, but in a solution of weak ammonia, in order to remove from the mercury any adhering salt of copper. Devergie has recommended tin;—but common tin is said to be often contaminated with mercury. There is no doubt that the silver test of Dr. Frampton is preferable to the use of tin. According to the experiments of this gentleman, mercury is easily separated by silver on long boiling, when the poison is in an extreme state of dilution. (Med. Gazette, Oct, 1843.) Dilution certainly interferes with the action of the galvanic test, for I could obtain no deposit on gold, from one-sixteenth of a grain of corrosive sublimate in sixteen ounces of porter.

It may be objected that this galvanic process only proves the presence of mercury: but a medical jurist can seldom do more. It would show that mercury was present in some tangible form; and the only common soluble salts of this metal are both highly poisonous,—namely, the bichloride and pernitrate:—whether the substance had acted as a poison or not, would be deter-

mined from symptoms and post-mortem appearances;—whether it had been given or intended as a medicine or not, would be easily determined from other circumstances. The only way to prove that the mercury was really in the form of corrosive sublimate, would be either by the discovery of some undissolved portions of the solid poison in the stomach or its contents:—or by a separation of the poison, when actually in solution, by means of ether. The addition of nitrate of silver to the contents of the stomach, or to an article of food, in order to detect the chlorine, would be in the highest degree objectionable; since the nitrate of silver is not only precipitated abundantly by most kinds of organic matter, but also by common salt, which, if not taken as an article of food, is always present naturally in the gastric secretions. Such an experiment might in certain cases be the basis of a chemical suspicion of the nature of the mercurial compound, but not of a medico-legal opinion.

Let us suppose that the filtered liquid contains no trace of a mercurial salt, we must now direct our attention to the analysis of the insoluble matters separated by filtration. These may be boiled in distilled water, the liquid filtered and tried by ether; if this does not succeed, it may be tried by the galvanic test. I have found that most of the compounds, which corrosive sublimate forms with organic matter, yield commonly sufficient poison for detection by boiling them in water, when the analysis has not long been delayed. But supposing that the solid matters,—even comprising the stomach itself, cut into pieces,—yield no traces of the poison, it will be difficult to obtain evidence of its presence;—the process to be presently described for detecting mercury in the organic tissues, may then be resorted to.

Dr. Christison has recommended the use of protochloride of tin as a precipitant in organic mixtures. If this be used, the precipitate should be well boiled in strong muriatic acid, and afterwards in potash, in order to separate from it any oxide of tin and organic matter. This process is indispensable, when we wish to ascertain the total quantity of mercury present, so that the quantity of corrosive sublimate may be determined. When the protochloride of tin does not give a precipitate in a suspected liquid, it is pretty certain that no mercury will be detected either by the galvanic or any other test. When the quantity of poison is small, I have found that there is much trouble and some risk of loss in attempting to separate the mercury by the protochloride of tin, and that it cannot be readily done. By means of the galvanic test, I was enabled to detect the one-sixteenth part of a grain of corrosive sublimate dissolved in one ounce of an organic liquid, and to obtain the metallic mercury from it in less than half an hour. The deposition on the gold was slow, but the mercury was entirely accumulated on the metal. Protochloride of tin gave an abundant precipitate with the same proportion of poison, but it was a much more troublesome and tedious process to obtain the mercury from the precipitate.

It is not possible to conceive a case where, in an analysis of this kind, the galvanic test would not be immediately applicable. This it will be observed is merely the medium for furnishing a ring of pure metallic mercury; and, as in the case of arsenic, it is not so much from the quantity of arsenic we obtain by the reduction process, as from the clear and undoubted evidence of its presence, in the physical and other properties of the metal;—so in the case of corrosive sublimate, it is not necessary to precipitate *all* the mercury in a given organic mixture, in order to say that this metal is there present. Thus, then, if from an organic liquid, by means of the galvanic test, we can obtain a distinct sublimate of mercury, we need not employ either the protochloride of tin or sulphuretted hydrogen gas, to separate the whole of the poison, unless our object be to determine the total quantity present. An arsenical sublimate weighing less than the 1-50th part of a grain, is evidence of the presence of that metal; the same is true of mercury, however the sublimate may be procured; and an operator has no more occasion to obtain all the mercury from the corrosive sublimate contained in a stomach, than he has to obtain all the arsenic from the arsenious acid diffused through the stomach and intestines in a case of arsenical poisoning.

Corrosive sublimate is not easily lost in organic liquids, when it is in moderate quantity. A few grains of this poison were mixed with some ounces of albumen, gruel and porter, in January 1839. An abundant precipitate was formed The mixture has been loosely exposed for *six* years: but the poison is now easily discovered by the protochloride of tin, by the galvanic test, and by metallic silver both in the supernatant liquid and in the precipitate. Corrrosive sublimate is not always found in the stomach of persons poisoned by it, although, from its readily combining with the mucous membrane, it is more likely to be detected than arsenic. In a well-marked case, which occurred to Mr. Watson, where two drachms killed a person in six days, none was found on a chemical analysis of the contents. This may have been partly due to the length of time that had elapsed. In Mr. Illingworth's case, where probably less was taken and death occurred rapidly, it was freely detected in a state of solution.

If a person has died under symptoms of mercurial poisoning, it will generally be sufficient that the chemical analysis should show that mercury was present in the contents of the viscera. In what form the mercury was taken, is a fact which must be proved by other circumstances: but it may be objected, whenever mercury is found in an insoluble state in the viscera or their contents, that it had been derived from some mercurial preparation administered medicinally, such as calomel, blue pill, or grey powder. This must be admitted: as the specific poison is not, in such cases, readily susceptible of detection; but the very obvious answer is, that symptoms and post-mortem appearances indicate the fact of poisoning and the analysis is merely corroborative. The discovery of a *soluble* compound of mercury in any suspected organic liquid, whether administered or not, must always remove the suspicion of its being derived from a medicinal preparation: if corrosive sublimate have itself been used as a medicine, it will be sufficiently apparent from circumstances. Besides the dose in such cases is always extremely small. (See p. 168.)

Detection of mercury in the tissues.—The recent experiments of MM. Danger and Flandin have removed any doubt which might have formerly existed, respecting the absorption of mercury in cases of poisoning. It is said that corrosive sublimate is itself absorbed, but I am not aware that there is any proof of this,—all we know is, that mercury has been extracted from the tissues of the body. The experimentalists above-mentioned have lately (March, 1845) presented a memoir to the Academy of Sciences, detailing their method of detecting absorbed mercury. They heat the animal matter finely cut up, to about 212° with one-third or one-half of its weight of strong sulphuric acid. In an hour or two, the whole forms a dark carbonaceous looking liquid. It is allowed to cool, and powdered chloride of lime is then gradually added. The liquid becomes whiter and more viscid. The quantity of chloride used is about equal to the weight of sulphuric acid: it is added until the whole appears like a white calcareous mass. The residue dried is then digested in absolute alcohol, which dissolves the mercurial compound: it is now diluted with distilled water, and the earthy residue is repeatedly washed,—the liquids being afterwards mixed and concentrated. The concentrated liquid is placed in a funnel terminating at an angle of 90° in a capillary point,—the galvanic plates of gold and tin being introduced into the contracted part of the funnel. In this way, every drop of the liquid comes in contact with the metals, and the gold is slowly covered with the mercury. It is stated that the metal has thus been detected in a solution containing the 100,000th part, which shows that the poison may be exceedingly diluted and yet susceptible of detection. These gentlemen have thus extracted mercury from rather more than three ounces of the liver of an animal poisoned by corrosive sublimate. What absolute quantity of the poison they have succeeded in detecting in their experiments is not stated. (See Comptes Rendus, 31 Mars, 1845, 951.) This is obviously nothing more than the old galvanic process, modified by allowing each particle of liquid to come slowly in contact with the metallic plates. Corrosive sublimate may be easily detected in organic

solids by boiling a small portion of the solid with copper gauze and a few drops of muriatic acid; or the plates of gold and zinc may be at once used. I have thus in one instance detected it in snuff.

QUANTITATIVE ANALYSIS.—If the poison be entirely in a soluble form, we may procure the mercury from a part only by the protochloride of tin and calculate the remainder proportionably. If it be in an insoluble form, we must then pursue the process recommended in the preceding page, and precipitate it entirely by the salt of tin, purifying the mercury by boiling it first in potash, and secondly in muriatic acid. For every 100 grains of metallic mercury obtained, we must allow 135 grains of crystallized corrosive sublimate to have been present.

CALOMEL. (CHLORIDE OF MERCURY.)—This substance, although commonly regarded as a mild medicine, is capable of destroying life, even in comparatively small doses. Several cases have been already referred to, where excessive salivation, gangrene of the salivary organs and death, followed from the medicinal dose of a few grains. For an additional instance of this kind, I must refer to the Med. Gazette, (xviii. 484,) wherein a boy, aged fourteen, was killed in about three weeks by a dose of only six grains of calomel. It is singular that in this case, neither the teeth nor the salivary glands were affected; still, considering the effects of calomel in other instances, it seems most probable, that the ulceration and gangrene of the face were due to it. Pereira mentions the case of a lady who was destroyed by swallowing twenty grains of calomel, she having previously taken a moderate dose without a sufficient effect being produced.

Sobernheim states that a girl, aged eleven, took in twenty-four hours eight grains of calomel, for an attack of tracheitis, and died in eight days from inflammation and ulceration of the mouth and fauces. In another case, which occurred to Lesser, fifteen grains of calomel produced similar effects with excessive salivation, and this patient also died in eight days. Meckel relates that twelve grains have destroyed life, (Lehrbuch der Ger. Med. 267). Two cases of death from calomel in children, are recorded in the Registration returns for 1840.

There are many other fatal cases on record, and the facts seem to leave no doubt that calomel may act as an irritant poison. It was supposed that these effects might be ascribed to this compound being adulterated with corrosive sublimate; but Dr. Christison examined ten different specimens of calomel without finding so much as one five-hundredth part of its weight of corrosive sublimate;—this would be less than a grain to an ounce; and in a common dose of three grains of calomel there would be no more than the one hundred and sixtieth part of a grain of corrosive sublimate,—a quantity insufficient to do mischief. (Ed. Med. and Sur. Jour. xlix. 336.) It has been further supposed that calomel might be converted into corrosive sublimate, by the free muriatic acid contained in the gastric secretions; but the very minute proportion in which this acid exists in the gastric juice, according to Dr. Prout, renders this explanation improbable.

It is a remarkable circumstance that calomel has often been taken in very large doses medicinally and accidentally, without producing dangerous consequences. Pereira states that upwards of five ounces of calomel were given in forty-two hours, to one cholora-patient,

without producing any sensible effect. (Med. Gaz. xviii. 468.) It may be objected, however, that we are hardly entitled to draw a fair inference of its effects on a healthy person, from exhibiting it in cases of disease; since, as it is well known, opium itself may be given in poisonous doses, to persons affected with certain diseases, without any injury resulting. The following case, however, shows, that even an ounce may be swallowed by a healthy person without serious effects resulting. A healthy girl, aged nineteen, swallowed about an ounce of calomel by mistake for magnesia. She took it in milk, and rinsed out the cup, so that the whole was swallowed except a few grains. The mistake was not discovered until two hours afterwards: she then experienced slight nausea and faintness. Emetics and lime-water were given, and in about half an hour, the larger portion of the calomel was discharged, mixed with mucus. Severe griping pains with tenderness of the abdomen came on; but in the course of four days, the girl had completely recovered without the salivatory organs having become in the least degree affected. (Med. Gaz. July 1838.) It is sufficient for a medical jurist to know that life has been destroyed by this medicine; and that death from calomel has become a subject of medico-legal investigation. In all such cases, it is likely that there will be some difference of opinion respecting the cause of death. For an interesting case of this kind, in which a man was tried for the murder of his wife, see Christison, (p. 384.)

There are various ways in which corrosive sublimate in solution may become partially decomposed and converted into calomel. Long exposure to light, especially of the alcoholic solution, is sufficient for this purpose. On the other hand, it is important to inquire in relation to a substance so extensively used for medicinal purposes, whether in some instances calomel may not become partly converted to corrosive sublimate within the body, and act as a poison. A case of some interest in relation to this point occurred recently in France. A physician prescribed for a child, powders, containing in each, five grains of muriate of ammonia, five grains of sugar, and half a grain of calomel. After taking a few of these powders the child died with all the symptoms of poisoning by corrosive sublimate; and the apothecary was charged with the death of the child, on the supposition that he had substituted corrosive sublimate for calomel. Experiments were instituted to ascertain, whether the calomel could have been decomposed by the ammoniacal salt; and it was satisfactorily proved, that a portion, at least, was converted into corrosive sublimate. M. Mialhe, who reports the case, has confirmed this result. He has found that calomel, when mixed with muriate of ammonia,—the chlorides of sodium, (common salt,) or potassium and distilled water, is partly transformed into corrosive sublimate and metallic mercury. I have found by many experiments, that the conversion takes place at common temperatures to so slight an extent as to be wholly unimportant.

Chemical Analysis.—Calomel is commonly seen in the form of a white powder with a faint yellow tint, so insoluble in water, that it is said to require

12,000 parts to dissolve one part. It is also insoluble in alcohol and ether, which may be thus usefully employed to separate from and detect in it, any traces of corrosive sublimate. Calomel, when long exposed to light, becomes deeper in colour: this is thought by some to be owing to its partial conversion to corrosive sublimate; but there is no evidence of any of this poisonous salt being thus produced. The specific gravity of calomel is much greater than that of corrosive sublimate; and owing to this property it is not difficult to separate it from organic liquids by decantation. Among the characters by which calomel may be identified, we may note the following:—1. Its insolubility in water;—it is soluble in strong nitric acid, but decomposed by it into corrosive sublimate and pernitrate of mercury. Strong muriatic acid transforms it to corrosive sublimate and metallic mercury. 2. When heated on platina over a spirit-lamp it is sublimed, but it is not so volatile as corrosive sublimate: during sublimation, it is partially decomposed into that substance and metallic mercury. 3. When dropped into a solution of iodide of potassium, it is slowly turned of a dingy greenish black colour; but if the iodide be much diluted, the powder acquires a yellow colour. 4. By a solution of potash, it is turned black. 5. It is also turned black by a solution of hydrosulphuret of ammonia. 6. It gives a silvery stain when rubbed on clean copper with a diluted acid. 7. It yields a ring of metallic mercury when heated with the carbonate of soda. 8. It is decomposed by a solution of protochloride of tin, and reduced to metallic mercury. In some of these characters it resembles corrosive sublimate, but it is eminently distinguished from that body by the first, third, and fourth. In addition to these differences, calomel is turned black by solution of ammonia, while corrosive sublimate forms a white compound. In order to detect its chlorine, it is necessary to boil the residue, left in the reduction tube after sublimation, in water; and add to the filtered liquid, neutralised by nitric acid, nitrate of silver.

White precipitate. (Ammonio-chloride of mercury.)—This is an irritant compound, although little is known concerning its effects. In January, 1840, a young woman was received into St. Thomas's Hospital, who had swallowed this substance, having mixed it up and taken it with water,—the quantity taken could not be ascertained. The stomach-pump was employed, mucilaginous drinks and olive-oil were administered; and in the course of a few days she perfectly recovered. The symptoms under which she suffered were those of gastric irritation. Judging from this case, white precipitate does not appear to be a very active preparation. One case of death from salivation produced by this compound, is recorded in the Registration returns for 1840, in a child, aged seven.

Chemical analysis.—This powder resembles corrosive sublimate in being entirely volatilized by a moderate heat, and in giving a metallic sublimate with dried carbonate of soda, but it differs in being insoluble in water. By heating it with solution of potash, ammonia is evolved, chloride of potassium formed, whereby the chlorine may be detected, and yellow peroxide of mercury, after long boiling, is left, which may be easily analyzed in the way already described.

Blue Pill.—The account of an inquest on a person alleged to have died from the effects of *blue pill*, will be found reported in the Medical Gazette, October, 1843. It appears that the deceased, æt. 40, took some medicine prescribed for him by a practitioner. It consisted of six grains of blue pill and three of calomel. This was alleged to have produced salivation and a mercurial fever, of which the man died in about seven weeks. The salivation was probably owing to a remarkable idiosyncrasy, for a smaller dose than that here prescribed has

been known to cause fatal salivation. But from the evidence, it was not improbable that the deceased had taken some quack pills which, had their composition been known, might have accounted for the severity of the symptoms. The jury returned a verdict of natural death, but called the remedy administered "an overdose of strong medicine!" (Pharm. Jour. Nov. 1843.) This compound can hardly be considered an active poison. According to some, the mercury in it is in a finely divided state, but it is probably partially oxidized. The only cases in which it has produced serious or fatal effects are those in which excessive salivation has followed its use.

RED PRECIPITATE. (RED OXIDE OF MERCURY.)—This is a poisonous substance commonly met with in crystalline scales of various shades of colour, from a dusky to a bright red, and forming an orange-coloured powder. It is poisonous, but instances of poisoning by it are very rare. The following case occurred at Guy's Hospital in 1833. A woman, aged twenty-two, who had swallowed a quantity of red precipitate, was brought in labouring under the following symptoms. The surface was cold and clammy,—there was stupor approaching to narcotism,—frothy discharge from the mouth, and occasional vomiting—the vomited matters containing some red powder, which was proved to be red precipitate. There was considerable pain in the abdomen, increased by pressure; and there were cramps in the lower extremities. On the following day, the fauces and mouth became painful, and the woman complained of a coppery taste. The treatment consisted in the use of the stomach-pump, and the administration of albumen and gluten. She left the hospital four days afterwards, still under the influence of mercury. The quantity of oxide here taken, was not ascertained.

Sobernheim reports a case, where a man, aged twenty-six, swallowed an ounce of red precipitate. He was speedily attacked with pain in the abdomen, nausea, purging, cramps and general weakness. The vomited matters consisted of masses of mucus, containing red precipitate. He continued to get worse, and died in less than forty-eight hours after taking the poison. On inspection, the mucous membrane was found eroded and inflamed in patches, small particles of the poison being imbedded in it. The duodenum was in a similar state, and there was a large quantity of red precipitate in the contents of this viscus, as well as in the stomach. (Op. cit. 250.) Niemann quotes a case in which six grains caused the death of a woman. (Taschenb der Arzneiw. 452.)

Notwithstanding the fatal result in these cases, red precipitate does not appear to be a very active poison. Thirty grains of it have been taken and retained in the system, with comparative impunity. Some years ago a young woman swallowed this quantity, with a suicidal intention. Almost immediately afterwards, emetics of ipecacuanha and sulphate of zinc were administered, and the stomach-pump was used repeatedly; but none of the red powder was ejected. She suffered chiefly from pain in the abdomen and general weakness, but in

the course of a few days she recovered. Devergie relates another instance of recovery in which a much larger dose had probably been taken. (Méd. Lég. ii. 705.)

CHEMICAL ANALYSIS.—Red precipitate is known,—1. By its being in red crystalline scales. 2. By its insolubility in water,—this, together with its great weight, renders it easy of separation from organic liquids. 3. It is readily dissolved by warm muriatic acid. forming a solution possessing all the properties of corrosive sublimate. 5. When heated in a small tube, it becomes black, (reacquiring its red colour on cooling,) and while an abundant sublimate of metallic mercury is formed, oxygen gas is evolved. If the heat be continued, it should be entirely dissipated when pure,—a property by which it is known from most other red powders. In this experiment a slight yellow sublimate is sometimes formed (subnitrate) owing to the oxide retaining some traces of nitric acid.

TURBITH MINERAL. (SUBSULPHATE OF PEROXIDE OF MERCURY.)—This is an irritant poison, and has caused death. One fatal case is reported to have occurred in 1837-8, but the particulars are unknown. Niemann states that this compound produces violent pain in the abdomen, vomiting and diarrhea. (Op. cit. 452.)

CHEMICAL ANALYSIS.—Turbith mineral is a heavy powder of a yellow colour, becoming of a dark olive by exposure to light. It is scarcely soluble in water, but has a strong metallic taste. When heated in a tube, with or without carbonate of soda, it yields metallic mercury. It is best analyzed by boiling it in potash, in which case sulphate of potash and peroxide of mercury result—the acid and the base are then easily determined.

CINNABAR. VERMILION. (PERSULPHURET OF MERCURY.)—The term cinnabar is applied to a dark and heavy compound of sulphur and mercury, while vermilion is the same substance reduced to a fine powder. It is well known as a pigment, and is often employed in colouring confectionary, wafers, &c. I have not been able to find any instance of its having acted as a poison on man. It has, however, proved fatal to animals in the proportion of from thirty to seventy grains, even when applied externally to a wound.

CHEMICAL ANALYSIS.—Vermilion is of a rich red colour, very heavy, and quite insoluble in water. When dropped into the hydrosulphuret of ammonia its colour remains unchanged; while red precipitate and red lead are turned of a dark brown colour, or even black. It is also known from red precipitate by its insolubility in muriatic acid. 1. When heated on platina it is entirely volatilized, the sulphur burning away. 2. Heated in a reduction tube with carbonate of soda, a sublimate of metallic mercury is obtained with a residue of sulphuret of sodium, in which sulphur may be easily proved to exist by the usual tests.

BICYANIDE OF MERCURY.—This is a substance but very little known, except to chemists, yet it is an active poison, and has caused death in one instance. In April, 1823, a person who had swallowed twenty-three grains and a half of this compound, was immediately seized with all the symptoms of poisoning by corrosive sublimate, and died in nine days. There was continued vomiting, excessive salivation, ulceration of the mouth and fauces, suppression of urine, purging,

and, lastly, convulsions of the extremities. On inspection, the mucous membrane of the stomach and intestinal canal, was extensively inflamed. As a poison, the bicyanide is probably not much inferior in activity to the bichloride of mercury.

Chemical analysis.—This is a white salt commonly crystallized in quadrangular prisms. It is very soluble in water, especially at the boiling point. The solution has no odour of prussic acid until an acid is added. Its solution is neutral, and is not precipitated by caustic potash. 1. If the powdered crystals be heated in a small tube, cyanogen gas is evolved and may be burnt at the mouth, the flame being of a rich rose-red colour, with a halo of blue; metallic mercury is at the same time sublimed. This experiment is alone sufficient to identify the poison. The solution of bicyanide is not unlikely to be mistaken for that of corrosive sublimate. It readily deposits mercury on copper and gold by the galvanic test, and it is precipitated black by hydrosulphuret of ammonia and sulphuretted hydrogen gas. It is known, 1. By potash giving no precipitate; 2. By prussic acid being evolved on boiling a portion with muriatic acid, corrosive sublimate being produced in the liquid; 3. By a scarlet precipitate being formed on adding to the solution iodide of potassium and muriatic acid.

Nitrates of mercury.—These are corrosive poisons which are used for several purposes in the arts. They are solid white salts, easily dissolved by water, especially if there be a little excess of acid present. The acid pernitrate has already caused death in an interesting case reported by Mr. Bigsley in the Medical Gazette (vi. 329). A butcher's boy dissolved some mercury in strong nitric acid, and swallowed about a teaspoonful of the solution. Soon afterwards he suffered the most excruciating pain in the pharynx, œsophagus and stomach:—there was great anxiety, with cold skin, small pulse, colic and purging. He became gradually weaker, and died in about two hours and a half. On inspection, the fauces, œsophagus and stomach, were found corroded and inflamed. Although he survived so short a time, the mucous membrane of the stomach was of a deep red colour.

The acid pernitrate has been used as a cautery, and also when diluted, as a lotion in diseases of the skin. Under these circumstances, it has been known to cause severe salivation, sloughing, and suppression of urine. A medical practitioner in France, was lately charged with malapraxis, in having improperly prescribed this solution as a wash for the itch. The skin of the body where the lotion had been employed, was discoloured and partly corroded; there was also pain in the throat, difficulty of swallowing, inflamed gums and salivation. The parties recovered from these effects in the course of a short time, and the charge was dismissed on the ground, that the lotion had been improperly used by the complainants; they had used it in a concentrated state, instead of diluting it with water as ordered by their medical attendant. (Ann. D'Hyg., Juillet, 1842.) There can be no doubt, that this poison is quite as formidable, both as a corrosive and irritant, as corrosive sublimate itself. The diluted protochloride of tin if timely applied, will counteract the local effects of these corrosive compounds of mercury.

Chemical analysis.—In the solid state, the crystals of acid *pernitrate*, when heated in a tube, yield nitrous acid vapour,—peroxide of mercury, and

a ring of metallic mercury,—when heated with carbonate of soda, metallic mercury is easily obtained. In *solution*, it is commonly met with in the state of a highly acid liquid, and nitric acid may be obtained on distillation, a result which does not occur with a mere solution of the crystals in water. The solution possesses all the properties of that of corrosive sublimate, so far as the tests for mercury are concerned ; but it gives no precipitate with nitrate of silver. On adding carbonate of potash and filtering, nitrate of potash is easily detected in the filtered liquid, and thus is the acid identified. On evaporating to dryness, and obtaining the solid crystals, they may be easily known from those of corrosive sublimate, by the simple application of heat. The *protonitrate* is known in solution, both from pernitrate and corrosive sublimate, in its being precipitated black by potash, and white by muriatic acid. This acid does not precipitate the solutions of either of the salts above mentioned.

The ACETATE is another soluble salt of mercury, but nothing is known respecting it as as a poison.

It may be proper to insert in this place the proportions in which mercury enters into various medicinal compounds belonging to the London Pharmacopœia, some of which, by causing death, have given rise to important medico-legal inquiries. Mercury with chalk (HYDRARGYRUM CUM CRETA) contains three grains of mercury in eight grains of powder. Blue pill (PILULÆ HYDRARGYRI) contains one grain of mercury in three grains. Compound calomel pill (PIL. HYD. CHLOR. COMP.) contains one grain of calomel in five grains. Iodide of mercury pill (PIL. HYD. IOD.) contains one grain of the iodide in five grains. Solution of corrosive sublimate (LIQUOR HYDRARGYRI BICHLORIDI) contains one grain of corrosive sublimate in two ounces of solution. The dose is from half a fluid drachm to two fluid drachms. For *external applications*.—Compound mercurial liniment (LIN. HYD. COMP.) contains about ten grains of mercury in one drachm. Strong mercurial ointment (UNG. HYD. FORT.) contains one drachm in two drachms; and the mild mercurial ointment (UNG. HYD. MITIUS) contains one drachm in six drachms. The red precipitate ointment (UNG. HYD. NIT. OXYDI) contains one ninth of its weight of red nitric oxide of mercury.

CHAPTER XVI.

ON POISONING BY LEAD AND ITS COMPOUNDS.

THE metal Lead is not commonly regarded as poisonous, but it is readily susceptible, by exposure to air and moisture, of being converted to a poisonous salt, the carbonate of lead. Many of its compounds are also much used in the arts, and have, on several occasions, given rise to serious accidents. Dr. Bryce has reported an interesting case, from which it would seem that lead is capable of exerting a poisonous action even in the metallic state. A man aged twenty-three, swallowed three ounces of small shot (No. 4), in three days. On the

third day there was great anxiety and depression, with sunken features, coldness of surface, dizziness and numbness in the arms and legs. He continued getting worse in spite of treatment; his bowels were obstinately torpid, and there was increased numbness in the arms and dizziness. Purgatives were exhibited; the alvine discharges examined, but only one pellet was found, so that if he passed the shot at all, it must have happened in the three days before he was seen by Dr. Bryce. This man perfectly recovered in a fortnight. (Lancet, Dec. 31, 1842.) Shot are known to be formed principally of lead, with some small portion of arsenic in the state of arsenuret or arseniate of lead. The quantity of arsenic is probably less than the 200th part of the weight of the shot; but the symptoms here appeared to show, that the effects were due to lead, and not to arsenic; the metal was probably oxidized and converted to an organic compound of lead, by the acid mucous secretions of the stomach. This case justifies the opinion that metallic lead cannot be strictly regarded as inert, or, if inert as a metal, it is susceptible of becoming speedily transformed to a poisonous salt within the body.

The only compounds of lead which have been found to produce poisonous effects upon the system, are the acetate, subacetate, chloride, carbonate, and the oxide of the metal combined either with vegetable acids or fatty substances. Dr. A. T. Thompson has expressed an opinion that the carbonate of lead is the only poisonous salt of this metal; and that, if any other salt in small doses become poisonous, it is only by its conversion to carbonate in the body; but as he admits that the acetate and subacetate may act as irritant poisons in large doses, and no toxicologist maintains that they are poisons when taken in small quantity, the difference of opinion appears to be more verbal than real. (See Med. Gaz. x. 689.) So far as observations on man have yet extended, the carbonate has no more action than the common acetate. Dr. C. G. Mitscherlich has lately proved, that the acetate of lead is a poisonous salt; and that when mixed with acetic acid, it is more energetic than when given in the neutral state. This fact clearly shows that the poisonous effects cannot solely depend on the assumed conversion of the salt to the state of carbonate. (Brit. and For. Med. Rev. No. vii. 208.)

Sugar of lead. (Acetate of lead.) This is more frequently taken as a poison than any other salt, although cases of acute poisoning by lead in any form, are very uncommon. In the Coroner's report for 1837-8, there is not a single case. The substance is commonly seen in solid crystalline masses, white or of a brownish-white colour; it much resembles loaf-sugar in appearance, and has often been mistaken for it. It has also a sweet taste, which is succeeded by an astringent or metallic taste. It is very soluble in water. Four parts of water at 60° will dissolve one part; and it is much more soluble at a boiling temperature. It is soluble in alcohol.

Symptoms.—Acetate of lead is by no means an active poison. In medical practice, it has often been given in considerable doses without

any serious effects resulting. When, however, the quantity taken, has been from one to two ounces, the following symptoms have been observed. A burning pricking sensation in the throat, with dryness and thirst:—vomiting supervenes; there is uneasiness in the epigastrium, which is sometimes followed by violent colic. The abdomen is tense, and the parietes have been occasionally drawn in. The pain is relieved by pressure, and has intermissions. There is constipation of the bowels. The skin is cold, and there is great prostration of strength. When the case is protracted, the patient has been observed to suffer from cramps in the calves of the legs, pain in the insides of the thighs, numbness and sometimes paralysis of the extremities. The affection of the nervous system is otherwise indicated by giddiness, torpor, and even coma.

Nothing is known concerning the *dose* required to destroy life. Thirty and forty grains have been given daily without serious effects. In one instance mentioned by Dr. Chowne, a person swallowed an ounce by mistake, and recovered under simple treatment.

Post-mortem appearances.—One case is recorded in which acetate of lead has proved fatal to man, but there is no account of the post-mortem appearances. A trial for murder by this substance took place at the Central Criminal Court in November, 1844, *Reg.* v. *Edwards*, but the details were so imperfectly reported as to throw no light upon the subject. The stomach and intestines were stated to have been found inflamed, and there were dark spots on the former. In animals, according to Dr. Mitscherlich, when the dose is large, the mucous coat of the stomach is attacked and corroded; this change appears to be purely chemical, and takes place in all the organs of the body with which the salt of lead comes in contact. If given in a small dose, it is decomposed by the gastric secretions, and exerts no corrosive power on the mucous membrane. When the acetate of lead was given in a state of albuminate dissolved by acetic acid, death took place with great rapidity; but on inspection the stomach was not found to be corroded. This property belongs to the neutral salt, and is not manifested when the dose is small, or when the poison is combined with an acid.

Treatment.—This consists in the free exhibition of solutions of the alkaline sulphates, either of soda or magnesia. The carbonates should be avoided, as the carbonate of lead is poisonous; while the sulphate is either inert or possesses but very little activity. An emetic of sulphate of zinc should be given, if vomiting does not already exist. The stomach-pump may be occasionally employed with benefit. It is well known that albumen precipitates the oxide of lead when added in large quantity; and Mitscherlich has found that casein, the albuminous principle of milk, is a very effectual precipitant of the oxide of lead. Therefore it would be advisable to administer, in cases of poisoning by the soluble salts of lead,—milk or albumen in large quantity. The compounds thus formed, as in the case of corrosive sublimate, may not be absolutely inert; but they are far less active than the

acetate itself, and tend to prevent the action of the poison as a corrosive on the stomach. Four cases are on record where individuals have recovered partly through treatment, after having swallowed one ounce of the acetate of lead.

GOULARD'S EXTRACT OF LEAD. (SUBACETATE. TRIACETATE OF LEAD.) Goulard's extract is generally seen under the form of a yellowish coloured liquid, as it is often made with common vinegar instead of acetic acid. This substance has caused death in at least four instances,—one in France and three in England. The symptoms produced are similar to those described in speaking of the former compound. The subacetate is much more powerful as a poison, than the neutral acetate, probably from its containing a larger quantity of the oxide of lead. One fatal case of poisoning by Goulard's extract is marked down in the Coroner's return for 1837-8; in January, 1840, two other cases of poisoning by it occurred in this city in two children, aged respectively four and six years. The quantity taken by the children could not have been very great, but they both died within thirty-six hours. The symptoms were at first violent vomiting and purging;—in one case they resembled those of Asiatic cholera. The bodies were inspected by Dr. Bird, and presented the following appearances. The mucous membrane of the stomach was of a grey colour, but otherwise perfectly healthy. The intestines were found much contracted, in one instance more so than in the other. On the other hand, Mr. Marshall mentions a case of recovery where two fluid ounces of Goulard's extract had been taken by mistake. (On Arsenic, 106.)

There is a case reported in most foreign works on Toxicology, where an inspection was made of the body of a man who had been killed by taking a quantity of Goulard's extract. He died within forty-eight hours, and there was well-marked inflammation of the alimentary canal from the œsophagus downwards. The villous coat of the stomach was completely softened, and the effused mucus was found to contain the poison.

It has been a question, whether in cases of poisoning by acetate of lead, the metal is absorbed and enters into the circulation. It is said to have been found by Tiedemann in the blood of animals poisoned by it. Orfila also detected lead in the urine of a female who swallowed an ounce of the acetate: but Dr. Mitscherlich was unable to find any traces of the metal in the blood or urine of poisoned animals. The general opinion, however, now is, that the metal is in some form or other absorbed into the system. (See page 176.)

CHEMICAL ANALYSIS.—Acetate of lead as a *solid*. 1. If a portion of the powder be heated in a small reduction-tube, it melts, then becomes solid; again melts, acquiring a dark colour, and giving off vapours of acetic acid;—a black mass is left in the tube, consisting of carbon and reduced metallic lead. There is no sublimate formed. 2. It is very soluble in water, even when cold; common water is turned milky by it, chiefly from the presence of carbonic acid and sulphates. 3. A small portion of the powder dropped into a saucer, containing a solution of iodide of potassium, acquires a fine yellow colour. 4. When dropped into caustic potash, it remains white;—5. into

hydro-sulphuret of ammonia it is turned black, in which respect it resembles the white salts of some other metals. 6. When the powder is boiled in a tube with diluted sulphuric acid, acetic acid, known by its odour and volatility, escapes.

All these properties, taken together, prove that the salt is acetate of lead.

Tests for the *solution*. If acetate of lead be presented in a state of solution, or if the solid salt be dissolved in water for the purpose of making further examination, we should note the following points. 1. A small quantity slowly evaporated on a slip of glass, will give white and opake prismatic crystals, which are turned yellow by iodide of potassium, and black by hydro-sulphuret of ammonia. The solution is said to be neutral; but I have found the common acetate of lead to have at the same time both an acid and alkaline reaction, i. e. reddening litmus paper, and turning rose paper green, a circumstance which might create some embarrassment in an analysis. 2. *Caustic potash*, added to the solution much diluted with water, throws down a white precipitate, which is easily soluble in an excess of the alkali. 3. *Diluted sulphuric acid* produces an abundant white precipitate, insoluble in nitric acid, but soluble in muriatic acid and in a large excess of caustic potash. 4. It is precipitated of a bright yellow colour by the *Iodide of potassium;* the yellow iodide of lead is soluble in caustic potash, forming a colourless solution. It is also dissolved by concentrated muriatic acid. 5. *Hydrosulphuret of ammonia* or sulphuretted hydrogen gas, produces a deep black precipitate, even when not more than the 100,000th part of the salt is dissolved. 6 Place a few drops of the solution on clean platina foil,—acidulate it with acetic acid, then apply, through the solution to the surface of the platina, a thin polished slip of zinc:—bright crystals of metallic lead are instantly deposited on the zinc: in this way a very small quantity of lead may be detected. 7. If a slip of zinc foil with a little acetic acid be introduced into the solution, there speedily takes place a deposit of metallic lead on the surface of the zinc. 8. If bibulous paper be repeatedly saturated with this or any salt of lead, dried and burnt, metallic lead is produced in minute globules, which may be collected and examined.

Objections to the tests.—It must be understood that the effects of these tests should be taken together, as the objection to any one is thus counteracted by the application of the others. With regard to potash, this gives a similar precipitate with the salts of barytes, strontia, lime and magnesia; but none of these precipitates are soluble in an excess of the alkali. Potash also precipitates alum and sulphate of zinc; and these precipitates, like that from lead, are soluble in an excess of caustic alkali, but the solutions of alum and zinc are not precipitated by sulphuric acid. Sulphuric acid gives a white precipitate with some other compounds; but these are known from sulphate of lead, by their insolubility in caustic potash, while the sulphate of lead is known from them by its solubility in concentrated muriatic acid. The action of iodide of potassium is peculiar. There are several objections to the fourth test; for the salts of mercury, silver, copper, cobalt, nickel, bismuth, and the protoxides of iron and tin, are precipitated by hydrosulphuret of ammonia, either of a black or dark brown colour. Some of the solutions of these salts are known by certain specific properties,—those of copper, cobalt and nickel, are coloured;—the solution of bismuth is decomposed and precipitated by water, while the salts of these metals do not give results similar to those of lead with the other tests, nor can lead be extracted from them by the galvanic or any other process.

The operator should be aware, that lead may be contained in many alkaline or saline liquids when they have been long kept in flint-glass bottles.

It is important to mention that all the precipitates of lead which are redissolved by caustic potash, are thrown down black by adding hydrosulphuret of ammonia to the respective alkaline solutions. This enables the operator to apply two or three tests to one portion of suspected liquid.

In organic mixtures and in the tissues of the body.—The acetate of lead is precipitated by many organic principles, especially by albumen and tannin. Thus, we may have to analyse either an organic liquid containing lead, or a

solid precipitate consisting of mucus or mucous membrane, intimately united to the oxide of lead. The liquid must be filtered and examined by a trial test, i. e. either by adding to a portion, sulphuric acid, or by exposing bibulous paper dipped into the suspected liquid, to a free current of sulphuretted hydrogen gas. If the paper be not stained brown, there is no perceptible quantity of lead dissolved;—if it be stained brown, we dilute the liquid if necessary in order to destroy its viscidity, and pass into it a current of sulphuretted hydrogen until all action has ceased. The black sulphuret of lead should be collected on a filter, washed and dried, then boiled for a quarter of an hour in a mixture of one part of nitric acid, diluted with four parts of water. This has the effect of transforming it, at least in part, to nitrate of lead soluble in water. This liquid, when filtered, may be cautiously neutralized by potash or ammonia, and the tests added. If the quantity be too small for the application of all the tests, we may add sulphuric acid;—if a white precipitate be formed, soluble in potash, and this solution again turned black by hydrosulphuret of ammonia, this is sufficient evidence of the presence of lead. Should there be no lead dissolved, we must decompose the solid and insoluble matters in nitric acid slightly diluted, at a boiling temperature, filter and test the filtered liquid, previously neutralized; or we may evaporate to dryness and redissolve the residue for testing.

If no result be obtained by either of these processes, it will be necessary to cut the stomach or other suspected solids to pieces; and after having dried them thoroughly, to incinerate them with four parts of black flux in a crucible. If lead be present, it will be found at the bottom of the crucible in the form of a metallic button, and the carbonaceous matters may be separated by washing the residue in water. The nature of the acid united to the lead, cannot of course be determined in such a case; but this would be unimportant to the inquiry, as all the salts of lead are poisonous, excepting perhaps the sulphate. It may be objected that lead is naturally contained in the animal tissues:—this is extremely doubtful, but admitting it to be true, the metal exists only in infinitesimal traces, whereas in a case of poisoning, it is likely, if obtained at all, to be obtained in pretty large quantity. (B. and F. Med. Rev., Oct. 1844, 549.) In poisoning by the subacetate, traces of lead have been found in the stomach three days after death; and there is no doubt, that it might be detected after many months have elapsed.

Goulard's extract.—This cannot be readily procured in a solid or crystalline state;—the solution is strongly alkaline, there being a much larger quantity of oxide of lead in it than in the common acetate. It possesses the reactions of that salt, but differs from it in being copiously precipitated by a solution of gum acacia.

Nitrate of lead.—This salt is commonly seen in solid tetrahedral crystals:—when powdered and heated in a reduction tube, it gives off nitrous acid vapour, and yellow protoxide of lead is left. It is readily dissolved by water; the solution is neutral and is not precipitated by tartaric acid, which distinguishes it from the two preceding salts. The nature of its acid is best determined by adding carbonate of potash to the solution,—and filtering:—the filtered liquid should on evaporation yield nitrate of potash. Or a grain of the salt may be dropped into sulphate of narcotine. (See Nitric acid, ante, p. 86.) All the tests for lead mentioned in speaking of the acetate, apply equally to this salt. Dr. Christison found that 400 grains of the nitrate killed a dog in sixteen hours. 549.

Chloride of Lead.—Some years since a woman was brought to Guy's Hospital, who had swallowed the chloride of lead: the quantity could not be ascertained, but a portion of the poison was found in the paper, out of which she had taken it. There were no urgent symptoms except vomiting: alkaline sulphates were exhibited, but she suffered so little inconvenience, that she left the hospital the same day and eventually did well.

CHEMICAL ANALYSIS.—This is a white pulverulent salt: when heated in a tube it fuses into a yellowish green mass and remains fixed—it is soluble in hot, but not very soluble in cold water; the solution gives the reactions indicated with the tests for lead: and the chlorine may be discovered by nitrate of silver. This salt is rendered more soluble in water by nitric or muriatic acid;—it is insoluble in alcohol.

TURNER'S YELLOW. (OXYCHLORIDE OF LEAD.)—This is commonly seen in the form of a fine yellow-coloured powder; it is sometimes called mineral yellow. Its action on the body is unknown; but it is much used in the arts, and as it might be mistaken for another substance, its chemical properties require a brief description.

ANALYSIS.—It is a very fusible substance, it melts when heated and remains fixed, it is partially soluble in caustic alkalies;—when digested in nitric acid, oxide of lead is dissolved and a milky white chloride of the metal remains.

CARBONATE OF LEAD. (WHITE LEAD. CERUSE.)—This substance is extensively used in the arts. It is commonly seen in the form of heavy white masses resembling chalk. It is insoluble in water, but still possesses poisonous properties, a decided proof, among numerous other facts, that insolubility does not prevent a substance from exerting a poisonous action on the system. The very small quantity of free acid contained in the gastric secretions, may dissolve a portion; but the quantity of carbonate required to neutralize the free acid in the stomach, would probably produce no serious symptoms whatever; since we commonly find it is only in large doses, that this substance acts as an irritant poison. A very interesting case of poisoning by the carbonate of lead, was reported in October, 1844, to the Westminster Medical Society by Mr. Snow. A child aged five years ate a portion not so large as a marble, ground up with oil. For three days he merely suffered from pain in the abdomen and costiveness. On the third night, the child became rapidly worse and there was vomiting. He died ninety hours after taking the poison, having passed some very offensive motions of a greenish black colour (probably from sulphuret of lead) before he died. The mucous membrane of the stomach, was much inflamed and of a dark red colour throughout. Poison could not be detected in the contents or tissues of the stomach or in the matter vomited. It is remarkable that in this case, so small a quantity should have proved fatal without exciting any marked symptoms of irritation in the first instance.

There are many fatal cases of poisoning by the carbonate of lead in the human subject, but it has in these proved insidiously fatal, by inducing *Colica pictonum*. They are cases of chronic poisoning, and are more interesting in a medical than in a medico-legal point of view. The following instance of recovery from a large dose of carbonate of lead, is reported by Mr. Cross.

A woman, aged thirty-three, took by mistake for a dose of magnesia, from six to eight drachms of carbonate of lead. Five hours afterwards, she was seen by her medical attendant; she was in a cold perspiration, breathing heavily, constantly vomiting, her pulse hard, small, and quick. There was

great anxiety of countenance, with dryness of the throat;—a sense of heat in the stomach, with very painful colics. Castor-oil and sulphate of magnesia, with diluted sulphuric acid, were given to her;—the last at frequent intervals. The extensor muscles became paralysed, and the flexors rigidly contracted,—the colics were so excruciating, that the patient generally fainted after each paroxysm. The evacuations from the bowels were of a very dark colour, probably from the action of sulphuretted hydrogen, contained in the intestines, upon the lead. The symptoms abated, but the next day there were nausea and faintness with griping pains. In four days she was convalescent. This case shows that the carbonate of lead, although poisonous, is not very energetic. Its action as a poison is probably not greater than that of the acetate; and so far as observations on the human subject extend, it is less active than the subacetate.

A case is related in the Annales d'Hygiène, (April, 1844,) which shows that serious accidents may sometimes happen from the shot used in cleaning bottles being left, and afterwards becoming chemically acted on by the wine or liquid introduced. The practice of thus cleaning bottles is very common in England and also in France; some of the pellets often become fixed in the narrow part of the base of the bottle and thus escape notice.

A person after having swallowed a few glasses of liqueur, suffered from the most violent colicky pains, and all the symptoms of irritant poisoning. Dr. Hanle, who was immediately called, having observed that the liquor remaining in the bottle was very turbid, poured it off for analysis, when he found, firmly wedged in at the bottom of the bottle, ten leaden pellets, which had become so completely transformed to carbonate of lead, that there was only a small nucleus of the metal left. So long as the liquor was clear, no accident had arisen from its use; but the symptoms of poisoning appeared immediately when the turbid portion, at the bottom of the bottle, containing the salt of lead either suspended or dissolved, was swallowed. (See p 53, ante.)

It is singular that the lead should have been found in this case in the state of insoluble carbonate; for, in general, the vegetable acids contained in wine (if we except the tartaric) form soluble salts of the metal. With acescent wines, such as those made in this country, which owe their acidity chiefly to citric acid, accidents of this kind are very liable to occur; but with good Spanish wines, they are not so common. The acidity here is chiefly due to tartaric acid; and it is only slowly that tartrate of lead is formed, even when the quantity of shot left in the bottle is large.

In respect to *treatment*, it is obvious that the alkaline sulphates could not here be employed as antidotes, since it requires long digestion at a high temperature, for these salts to react on the carbonate of lead, and even then the decomposition is only partial. I would suggest, in a case of this kind, the expediency of administering an alkaline sulphate mixed with vinegar or some weak vegetable acid, such as lemon juice. Emetics and the stomach-pump should also be employed.

Painter's colic may be regarded as the chronic form of poisoning by carbonate of lead, indicated by violent pains in the bowels, constipation and paralysis. The carbonate finds its way into the system, among white-lead manufacturers, either through the skin or through the lungs, or both together;—it becomes diffused in a fine powder through the atmosphere, and thus enters into the lungs. It has been remarked in France, that in manufactories, where the powder was ground dry, not only have the labourers suffered, but also horses, dogs and even rats, have died from its effects. Since the practice has arisen of grinding the carbonate in water, cases of colica pictonum have not been so numerous. They are still, however, frequent among painters, the manufacturers of some kinds of glazed cards, and among

those engaged in the glazing of pottery, where oxide of lead is employed in the glaze. Paralysis has been known to arise from the inhalation of lead where a person had long worked in a recently painted room, (Lancet, Oct. 26, 1844,) and I have myself suffered from severe colic under similar circumstances.

The diagnostic symptoms of this disease are well marked. One of a peculiar nature has been lately pointed out by Dr. Burton, namely, a blueness of the edges of the gums, where these join the bodies of the teeth, but there is some doubt about this alleged character of lead poisoning. Dr. Chowne states that from inquiry and observation, he satisfied that the presence or absence of this blue line is not connec with the administration or non-administration of lead. (Lancet, Oct. 1844.) The disease often kills the patient; and after death, the int tines are found contracted, especially the colon. M Grisolle ma numerous analyses of the fluids and viscera in fatal cases of painter colic without detecting any traces of the metal. The urine of work men, employed in white-lead manufactories, has been repeatedly exa mined, but no lead has been discovered in it. This was owing probably to some defect in the analysis or to the very small quantity absorbed; because the tests for lead are remarkably delicate, and would detect it, were it in no larger proportion than the 200,000th part of the liquid examined. Still, however, recent researches have shown that the metal is absorbed in some form, probably in all cases of lead poisoning. In acute cases it has been detected in the blood, muscles and viscera; and it has been lately discovered by Professor Cozzi in the blood in cases of painter's colic. In the following instance I have reason to believe that it existed in the milk.

A few years since a cow drank up a large quantity of paint, of which carbonate of lead was the chief ingredient. The animal suffered severely;—sulphate of soda was largely exhibited, and the cow eventually recovered. While the animal was labouring under the effects of the poison, a quart of milk was drawn from it, put into a glass bottle, and sent to me for examination. I found that sulphuretted hydrogen gas gave with it a minute black flaky precipitate, which appeared to be sulphuret of lead. I tried several other specimens of milk, obtained in the usual way from London dealers, without finding that they were in the least affected by a current of sulphuretted hydrogen gas. (See Guy's Hosp. Rep. No. 12.) This result seems to show that in poisoning by white lead, the metal is taken up in some form and excreted. This, however, was an acute case of poisoning, a fact which may explain the difference in the analytical results.

One other form of poisoning by carbonate of lead is of some interest to the medical jurist,—I allude to the impregnation of *water* with this substance by contact with metallic lead. This metal, it is well known, is largely used for water-cisterns and pipes; and, under certain circumstances, hydrated oxide and carbonate of lead are apt to be formed in large quantity, and to be diffused in the water. It has been supposed that carbonic acid in the water would partially dissolve, and suspend the carbonate in it; but in saturating water with carbonic acid, over finely divided carbonate of lead, it was not found on filtration that any perceptible

portion had been dissolved. This change is chiefly observed to take place with new lead, or the metal which has a bright and polished surface. Old lead does not easily produce the oxide or the carbonate, the metal being protected by the crust already formed on it and firmly adhering to it It is important for the medical jurist to bear in mind that the purer the water or the less saline matter it contains, the more it is liable to acquire this poisonous impregnation. When water thus contaminated with carbonate of lead is used, symptoms of poisoning may suddenly affect a whole family, without the cause being at first apparent; or one or more cases of chronic poisoning by lead, may unexpectedly show themselves among the members of a household where such water is drunk. This subject has been most fully examined by Dr. Christison. I have repeated his experiments, and made some others, the result of which will be found elsewhere. (Guy's Hosp. Rep. No. vi.)

My experiments have led me to the conclusion, that sulphate of lime is the salt which, by its presence in most kinds of hard water, prevents this action on lead. When this salt forms only the 5,000th part of the weight of water, no carbonate of lead is formed;—and the sulphate of lime, dissolved in this or in a larger proportion in distilled water, will confer on it the properties possessed by river water. Sulphate of lead appears to be slowly formed; this closely invests the metal, and prevents the production of any loose crystalline carbonate. Thus then a water, which is abundantly precipitated by a salt of barytes, and by oxalate of ammonia, is, cæteris paribus, not very likely to give rise to lead colic by passing through lead pipes, or being preserved in leaden cisterns. The facts connected with the contamination of water by lead are of great interest. In a trial which took place at the Surrey Lent Assizes, 1845, (*Solomon* v. *Lawson*, see antè, p. 29,) these facts were of some importance, and the effects of water so poisoned, on the system, were closely investigated. (See Brit. and For. Med. Rev. Oct. 1844, 546.)

Chemical analysis.—Carbonate of lead is a solid white powder, insoluble in water, and immediately blackened by sulphuretted hydrogen or hydrosulphuret of ammonia. 1. When heated on platina, it leaves a residue of yellow or orange-coloured oxide of lead, soluble in nitric acid. 2. The carbonate is easily dissolved by diluted nitric acid with effervescence, which shows that it contains carbonic acid. The oxide of lead, combined with nitric acid, may be readily detected by the tests already mentioned. If the carbonate be mixed with sulphate of lead or sulphate of barytes, these bodies will remain undissolved by nitric acid. The salt may be easily reduced on charcoal by the blow-pipe and metallic lead procured.

Sulphate of lead.—This, owing to its great insolubility, is considered not to be a poisonous salt; but it is by no means certain that large doses of it could be taken with impunity. It is, perhaps, not more insoluble than carbonate of lead, calomel, or Scheele's green; and yet these are known to act on the body. There is, however, good reason to believe that its action, if any, is considerably less, than that of the other salts of the metal; and on this fact, the antidotal treatment of lead-poisoning by alkaline sulphates, is based.

In a case of poisoning, owing to the administration of antidotes, this salt of lead may be found in the stomach, scattered in white masses over the mucous membrane. Being very heavy, it will not be difficult to separate it by decantation; and, as it is quite insoluble in water and most acids, it will be proper to describe the method of determining its nature.

CHEMICAL ANALYSIS.—Sulphate of lead is a white solid, resembling the carbonate by its insolubility in water, but differing from it in not being soluble in acids, except (on boiling) in strong muriatic acid without effervescence. 1. When dropped into the hydrosulphuret of ammonia, it is blackened; and thus it is known from the sulphate of barytes, which it otherwise resembles. 2. When heated on platina foil, it remains unchanged, or becomes only slightly darkened, if any organic matter be mixed with it or the flame of the lamp come in contact with it. 3. When suspended in water, and a current of sulphuretted hydrogen is passed through it,—black sulphuret of lead is precipitated, (for the analysis of which, see antè, p. 173,) and sulphuric acid is dissolved by the water, in which, after evaporation to get rid of the sulphuretted hydrogen gas, it may be detected by the appropriate test, namely, a salt of barytes. Or 4th, heat the sulphate over a spirit-lamp in a small glass tube with its bulk of cyanide of potassium. It is thus converted to sulphuret; this may be digested in water and nitric acid as already explained, and a soluble nitrate of lead is thus obtained in a few minutes.

CHROMATE OF LEAD.—This is a poisonous salt of lead well-known by its brilliant yellow-colour. It is easily to be procured at all colour-shops, and may thence give rise to accidents. I have not met with any case of poisoning by it in the human subject, but it would doubtless act like the other salts, i. e. by producing paralysis or painter's colic when frequently exhibited in small doses, and symptoms of irritation when taken in large quantities. The chromic acid would also operate as an irritant. It is sometimes used for giving a yellow-colour to confectionary and when mixed with indigo, a green. In this state, it has produced colic and other alarming symptoms. (See Ann. D'Hyg. 1829, 421.)

CHEMICAL ANALYSIS.—The intense yellow colour of this compound distinguishes it from all other substances, except orpiment and sulphuret of cadmium. From these it is well known by being immediately turned of a greenish black colour by sulphuretted hydrogen or the hydrosulphuret of ammonia. It is quite insoluble in water, but is soluble in nitric acid, in potash, (in which respect it resembles orpiment) and in muriatic acid, which forms with it chloride of lead and a mixture of muriatic and chromic acids. On boiling this mixture, chlorine is evolved and green oxide of chrome is set free. When long boiled with carbonate of potash, it forms insoluble carbonate of lead, and soluble chromate of potash.

OXIDES OF LEAD.—The yellow oxide (massicot) and the brown oxide (peroxide) are but little known except to chemists. Litharge and minium (red lead) are, however, much used in the arts, and have sometimes given rise to accidental poisoning. Liquids used for culinary or dietetic purposes, especially if they contain a free acid, are liable to become impregnated with oxide of lead, derived from the glaze of the vessel in which they are kept, and to form poisonous salts. If vinegar be used, acetate of lead may result. Litharge-glaze is also easily dissolved by alkaline

or fatty substances. The eating of dripping or the fat of meat, baked in a newly glazed vessel, has thus been known to give rise to slight attacks of colic; while the symptoms were referred by the party to some substance mixed with the food. When articles of this kind are impregnated with oxide of lead, the fact is immediately known by their being turned more or less of a brown colour by hydrosulphuret of ammonia. All newly glazed vessels yield more or less traces of lead, on boiling in them acetic acid or caustic potash. In this way the poisonous nature of the glaze may be tested. The oxide of lead is dissolved by the acid or the alkali. Litharge was formerly much used to remove the acidity of sour wine, and convey a sweet taste. Acetate of lead, or some other vegetable salt of the metal, is in these cases formed; and the use of such wine may be productive of alarming symptoms. Many years since a fatal epidemic colic prevailed in Paris owing to this cause. The adulteration was discovered by Fourcroy, and it was immediately suppressed. Such wine is known by its being blackened by hydrosulphuret of ammonia. Snuff has been found to be adulterated with red lead: in one instance this mixture is supposed to have caused death, and in another, it gave rise to alarming symptoms. (Med. Gaz. xxxii. 138; also Ann. D'Hyg. 1831, ii. 197.)

It is well known that lead shot are much employed for the purpose of cleaning wine bottles, and that a number of pellets are frequently left in the bottles, whence a question has arisen, whether *wine* introduced into them is liable to acquire a poisonous impregnation from lead. I have found that when the shot were in much larger proportion than could ever be left by accident in a wine bottle,—good wine, whether port or sherry, became slowly impregnated with lead. After two or three months, a white sediment had formed, but no lead was dissolved; after thirteen months, the port wine retained its colour, and scarcely any portion of lead was dissolved by it: the sherry had become darker in colour, and the presence of lead was very evident in it. It is now nearly six years since the experiment was commenced, and the port wine still has a dull red colour, and gives only faint traces of lead with hydrosulphuret of ammonia and sulphuretted hydrogen gas: —the sherry has acquired a very pale straw colour, and is pretty strongly impregnated with lead. Thus, then, even under the most favourable circumstances, good wine is but slowly contaminated by contact with lead. Acid wines, such as those made from the currant or gooseberry, might, however, become much more rapidly impregnated with the metal, and in a quantity sufficient to produce colic or other serious symptoms.

Cyder is apt to become poisoned with the salts of lead when it comes in contact with that metal. It has been generally supposed that the only poisonous compound produced in this case is the insoluble malate; and it appears from an accident which occurred lately in France, where six persons were seized with symptoms of lead-poisoning from drinking cyder, that Chevallier and Ollivier discovered the poisonous salt to be the malate of lead. A large quan-

tity of acid may probably suspend this and other vegetable salts which are reputed to be insoluble; or it may happen that, like the carbonate of lead in water, the insoluble salt may be diffused through the liquid, and suspended in an extreme state of division. In some instances the carbonate of lead itself may be formed and act as the poison. A case of this kind has been already given, (see antè p. 175).

New rum, as it is made in the West Indies, often contains lead derived from the worm of the still, and lead colic frequently attacks those who drink it. *Old rum*, on the other hand, is by no means unwholesome, and is therefore in great demand. Dr. Traill gives the following explanation of this difference in properties. He found that the rum which was received in glass bottles from the still, was always impregnated with lead; but when kept in oak casks, the tannin of the oak is slowly dissolved by the spirit and precipitates the lead in an insoluble form, the spirit thereby becoming perfectly wholesome. He has suggested that a little decoction of oak bark, added to the new rum, would equally render it innoxious. (Outlines, 112.)

It has been found that *sugar* is sometimes the medium of conveying lead-poison into the system, and giving rise to attacks of colic in those who partake of it. Dr. Jackson has reported an instance of this kind, in which several persons lost their lives, and many others were attacked with paralysis and colic, who had partaken of sugar which had probably been kept in leaden reservoirs. Lead was discovered in the sugar in large quantity. (Med. Gaz. xvii. 1036.)

Chemical analysis.—Litharge is commonly seen in reddish or yellow-coloured scaly crystals, insoluble in water, but soluble in great part, or if pure, entirely in dilute nitric acid. The solution possesses all the characters of nitrate of lead. Minium or red lead is commonly seen as a rich orange-red powder;—it is partially dissolved by acids,—a portion of brown peroxide being left. The solution gives the usual reactions with the tests for lead. Both of these oxides are easily reduced on charcoal by the aid of a blow-pipe; or by mixing them with paste,—painting with this mixture a piece of card, drying it and burning it when metallic lead is immediately produced. Minium is known from vermilion among other properties, by its being blackened by hydrosulphuret of ammonia; from red oxide of mercury, by the action of nitric acid, as well as by the effect of heat. Red oxide of mercury is entirely dissipated when heated into oxygen and mercury,—minium gives off oxygen, but remains fixed as an orange-yellow oxide of lead. It is a common colouring matter in red wafers. The brown or peroxide of lead does not often require to be examined. It is converted to yellow protoxide soluble in nitric acid, by boiling it with a few grains of gallic acid.

Oxide of lead has been known to affect the system even when applied to the skin, and it is proper to state that most *hair-dyes* are composed of a mixture of lime and oxide or a subsalt of lead. (See Ann. D'Hyg. 1832, ii. 324.) The long-continued use of these preparations may give rise to symptoms, for the origin of which a practitioner would not be able to account. Dr. Bruck of Hanover observed that a violent ophthalmia was induced in a lady who had used for dyeing her hair, a substance called *poudre d'Italie*, which on chemical analysis was found to consist of lead and lime. (Med. Gaz. Nov. 1842.) Al-

though these hair-dyes are much used in England, I have not heard of any ill effects following their employment.

Quantitative analysis.—This may perhaps be most conveniently effected by converting the salt of lead to sulphuret by passing into it, either suspended or dissolved in water or acids, a stream of sulphuretted hydrogen gas. The precipitate should be well washed, dried, and weighed. Every 100 parts of sulphuret are equal to 158·3 of crystallized acetate: 138·3 of crystallized nitrate; 116·6 of chloride and 111·6 of carbonate of lead.

CHAPTER XVII.

ON POISONING BY COPPER AND ITS COMPOUNDS.

Copper itself is said to be destitute of poisonous properties; but it would appear that when alloyed with other metals and reduced to a finely pulverulent state, it may act as a poison. A singular instance of this kind occurred lately in London. The printing in gold, as it is termed, is performed by means of a species of bronze or copper alloy. The letters are printed with a mixture of size and gamboge; and the copper alloy, reduced to such a fine state of division that it floats in the atmosphere in an impalpable dust, is then brushed over the surface. A boy employed in this occupation was, on the third day, seized with vomiting of a green coloured fluid, heat and constriction in the æsophagus, pain in the stomach, loss of appetite and rest, and a severe itching in all those parts which were covered with hair. These on examination were found to be of a deep green colour. The boy soon recovered. About twelve other persons, employed in the same work, suffered from similar symptoms; but this did not prevent them from continuing the work. The poison in this case probably entered the system through the lungs and skin. This peculiar effect of finely divided copper in giving a green tint to those parts covered with hair, is mentioned by Dr. Falconer in his Essay on the Poison of Copper, (p. 42,) published in 1774.

Sulphate of copper.—All the salts of copper are poisonous. The two most commonly known are the sulphate (blue vitriol) and the subacetate (verdigris). These substances have been frequently taken and administered in large doses for the purposes of suicide and in attempts at murder. In the latter case, the attempt has been immediately discovered, owing to the strong metallic taste possessed by the salt. This would in general render it impossible that the poison should be taken unknowingly. With the exception of these salts, poisoning by copper is usually the accidental result of the common use of this metal for culinary purposes.

Symptoms.—Sulphate of copper has been frequently given for the purpose of procuring abortion. In doses of half an ounce and upwards it acts as a powerful irritant, and in very young children a much less quantity would probably suffice to kill. The salt speedily induces

vomiting of the most violent kind; this sometimes effectually expels the poison from the stomach, and the person recovers. The *vomited* matters are remarkable for being of a *blue* or *green* colour, and broken crystals of blue vitriol have been discovered in them, where the poison was taken in a loosely pulverulent state. There is pain in the abdomen, with diarrhea; and in aggravated cases, spasms of the extremities. Dr. Perceval met with a case where the most violent convulsions were produced in a young female by two drachms of the sulphate of copper;—she eventually recovered. Paralysis, insensibility, and even tetanus, have preceded death, when the poison was administered to animals. Among the symptoms casually met with in the human subject may be mentioned jaundice. This has been observed to attend poisoning by the sulphate, as well as by Scheele's green.

I have been able to find only one instance in which this poison has proved fatal in the human subject: it occurred in London in 1836. A girl sixteen months old, put some pieces of *Blue stone* (sulphate of copper) which were given her to play with, into her mouth. In a quarter of an hour, the child vomited a blueish green coloured matter with pieces of sulphate of copper in it; the skin was alternately cold and hot, but there was neither diarrhea nor convulsions. The child died in *four hours*, and was insensible before death. The coroner and jury did not consider it necessary that an inspection should be made, and yet in the event of murder being committed by the administration of this substance, it would be somewhat unreasonably expected that the medical witnesses should be fully acquainted with the post-mortem appearances produced by it!

THE SUBACETATE OF COPPER (VERDIGRIS) produces somewhat similar symptoms. Vomiting of a green-coloured liquid and diarrhea are the most prominent symptoms. In a case reported by Pyl, a woman who took two ounces of verdigris, died in three days:—in addition to the symptoms above described there were convulsions and paralysis before death. Niemann relates that a female, aged twenty-four, swallowed half an ounce of verdigris, and died under symptoms of violent gastric irritation in sixty hours. (Taschenbuch, 458.)

One case of poisoning by this substance is reported in the Edinburgh Medical and Surgical Journal for July, 1844. A woman, aged twenty-eight, swallowed a large dose of verdigris. She was soon afterwards seized with great anxiety, vomiting, acute pains, and swelling of the abdomen, sensation of burning heat in the throat, coldness, and severe cramp in the extremities, a labouring pulse, swelling of the face, with the eyes sparkling. An emetic brought away some half-digested food, without any traces of poison. The next morning there was painful deglutition, swelling of the throat, the abdomen tympanitic and painful on the least pressure, the countenance heavy, the face flushed, ahd the pulse oppressed. About two pounds of a distinctly-greenish fluid, with some blood were ejected. The symptoms became aggravated; the face and eyelids swollen and red, the eyes prominent, the abdomen flattened but sensible, the rectum so irritable and painful that enemata could not be administered. On the second day there was a tendency to coma, the face was pale, the lips swollen, the gums ulcerated, and there was an abundant discharge of viscid saliva. A copious stool was passed—the first

since the poisoning; and acetate of copper was detected in it in pretty large quantity. There were several spasmodic fits. On the third day some viscid glairy matter, of a greenish colour and tinged with blood, was vomited, and the spasms continued. On the fourth day bleeding from the nose with general cramps came on, and the urine and fæces were suppressed. There was coldness of the surface, with convulsions. After the lapse of about a week she still had vomitings of greenish glairy matters, with uneasiness in the abdomen: but from this date she gradually recovered. This case is interesting from the course of the symptoms being accurately noted; and it is worthy of remark, that icterus, which some have regarded as a symptom of cupreous poisoning, was at no time present. It is unfortunate that the quantity swallowed was not known.

Subchloride of copper. Oxychloride or Brunswick green. —This is a rich green compound which is formed where common salt has been used in a copper vessel, and has thus given rise to accidental poisoning. It is also used as a pigment.

The following is a case of poisoning by it reported in Henke's Zeitschrift der S. A. i. 188, 1844. A boy between two and three years of age swallowed a part of a small cake of green water-colour, such as is sold in the colour-boxes for children. Very soon afterwards he was attacked with vomiting and coldness of the extremities. Notwithstanding the exhibition of an antimonial emetic, the symptoms continued to become aggravated, and the child died. On opening the body, there was nothing to indicate specially the action of an irritant poison, except a slight congestion in the cerebral vessels. The child, it appears, had swallowed about a scruple of the green colour, which, on analysis, was proved to be the common subchloride of copper. It was remarkable that there was not the least sign of irritation or inflammation in the alimentary canal. Death was ascribed to the exhaustion resulting from violent vomiting, and the congestion of blood in the brain thereby produced. This case, the details of which are rather imperfectly given, shows that the subchloride of copper is a very active poison, and that it may cause death without leaving any signs of irritation in the alimentary canal. It is to be remembered that it is this compound of copper which is often formed in culinary utensils, and which thereby gives rise to accidents, when any food containing salt has been prepared in the vessel without proper precautions. (See Journal de Pharmacie, Juin 1845, 471.)

Arsenite of copper. Scheele's green.—This compound is extensively used as a pigment in the arts; it is also improperly employed to give a green colour to wafers and articles of confectionary. Dr. Geoghegan informed me that an accident occurred in Dublin in 1842, by which fourteen children suffered from symptoms of poisoning in consequence of their having eaten some confectionary ornaments coloured with Scheele's green. In two or three of these cases jaundice followed. The dangerous practice of using this powerful poison to give a colour to confectionary is very prevalent, and accidents often arise from this cause. An instance has lately been communicated to me, of recent occurrence, in which three lives were nearly sacrificed at a school near Manchester, owing to the parties having eaten some ornamented confectionary, which owed its green colour to arsenite of copper. They suffered from violent vomiting, severe pains in the stomach and bowels, and spasms in the extremities. Three animals which ate of the vomited matters were attacked by similar symptoms. It is unfortunate that in this country there is no medical police established by law to restrict the free sale and use of this and

other poisons. In this respect the English is widely distinguished from the continental practice. In France and Germany the lives of individuals are closely protected against those accidents which are liable to occur through the ignorance or criminal neglect of others. Here poison is allowed to be sold like sugar or starch; and every child is assumed by the law to be capable of protecting himself! If death ensue from such a cause, we find that a coroner's inquisition and a trial for manslaughter take place, to investigate an event which, under simple medical-police regulations, would not have occurred.

POST-MORTEM APPEARANCES.—In poisoning by the salts of copper, the mucous membrane of the stomach and intestines has been found more or less inflamed in the few fatal cases which have been examined—the membrane has been found also eroded and softened in poisoning by verdigris. The œsophagus has presented an inflammatory appearance. The lining membrane of the alimentary canal is often throughout of a deep green colour, owing to the small particles of verdigris adhering to it. It has been said, that this is an uncertain character of poisoning by copper; since a morbid state of the bile often gives a similar colour to the mucous membrane of the stomach and duodenum. This objection cannot apply, where the green colour is also found in the œsophagus, and throughout the intestines: and, under any circumstances, the evidence from the presence of a green colour would amount to nothing in the judgment of a prudent witness, unless copper were freely detected in the parts so coloured. It is well to remember that the green stain, if due to copper, would be turned blue by ammonia. The salts of copper are undoubtedly capable of acting as poisons when applied to a wounded or ulcerated surface. (See Med. Gaz. xxxv. 828.)

TREATMENT.—In general there is violent vomiting,—the salts of copper acting powerfully as emetics. The efforts of the stomach should be promoted by the free exhibition of warm water, milk, or any mucilaginous drink, and the use of the stomach-pump. This latter instrument is of little service, where the poison has been taken in coarse powder, as generally happens. Various antidotes have been proposed. Sugar was formerly strongly recommended, on the principle that it had the property of reducing the salts of copper to the state of insoluble red oxide; but this is only under very peculiar circumstances, not likely to be met with in the stomach. (Annales D'Hyg. 1833, ii. 207.) M. Postel is still inclined to regard it as an antidote, although it seems that animals to which he administered it died; but not *so rapidly* as when the poison was allowed to act by itself! Albumen is well known to form an insoluble compound with oxide of copper, provided the albumen be in very large excess; for the albuminate of copper is easily dissolved by an excess of the solution of sulphate. How far this would act on the insoluble part of verdigris (Tris-acetate) it is difficult to say; as also whether the albuminate be not itself a poison; still it may reduce the activity of the soluble salts of copper, and thus it is advisable to administer albumen both of the yolk and white of egg, conjointly with the other means recom-

mended. Dr. Edwards, some years since, recommended the use of iron filings for precipitating the copper; but the action in this case is too slow, and is immediately arrested by the iron becoming enveloped by a thin film of copper. If the iron even precipitated all the copper in the metallic state, sulphate of iron would be found in the stomach, and this is itself an irritant. The hydrated oxide of iron has been used in Germany in poisoning with arsenite of copper. A child swallowed a small quantity of green paint containing arsenite of copper: violent vomiting supervened with coldness of surface,—milk was given, and afterwards the hydrated oxide of iron. In five hours the vomiting had abated, and the child recovered. (Med. Gaz. xxxi. 270.) It does not appear to me that the recovery could here be ascribed to the effect of the supposed antidote. Even if arsenite of iron were formed by a reaction on the insoluble arsenite of copper, the former has been proved to be as poisonous as the latter.

Chemical analysis.—The salts of copper are generally known by their colour: whether in the solid state or in solution, they are either blue or green;—the salts of one other metal are also of a green colour, namely, nickel; but there are striking chemical differences between the salts of this metal and those of copper. There are *three* very *soluble* salts of copper; two of these are blue,—the sulphate and nitrate, and one green, the chloride. The salt should be dissolved in water, diluted, and the following tests may be then applied. The solutions of the cupreous salts generally have an acid reaction. 1. *Solution of ammonia:* this gives, in a solution of copper, a blueish white precipitate, which is soluble in an excess of the test, forming a deep violet-blue solution. 2. *Ferrocyanate of potash*, a rich claret-red precipitate;—if the quantity of copper be small, the liquid acquires merely a light red-brown colour. The ferrocyanate of potash will act on the violet-blue solution produced by ammonia, provided it be much diluted or an acid added (sulphuric) to neutralize the ammonia. The same quantity of liquid may thus be tried by several tests. 3. *Sulphuretted hydrogen gas*, or hydrosulphuret of ammonia, gives a deep chocolate-brown precipitate, or merely a brown colour, if the copper be in small proportion. 4. A slip of *polished iron* (a common needle) suspended by a thread in the liquid, is speedily coated with a layer of copper, even where the salt is in very small proportion. When much diluted, a drop of diluted sulphuric acid may be added. If the needle be left for some days in the liquid, the iron will be slowly removed, and a hollow cylinder of metallic copper will remain. This may be dissolved in diluted nitric acid, and tested with the foregoing tests. Half a grain of sulphate of copper dissolved in sixteen ounces of water, may be thus easily detected. Among these tests the ferrocyanate of potash and sulphuretted hydrogen gas will produce a marked action on a quantity of the cupreous salt, in which polished iron has no effect. 5. If a few drops of the copper solution be placed on platina foil,—slightly acidulated with a diluted acid, and the platina be then touched through the solution with a thin slip of zinc, metallic copper of its well-known red colour, is immediately deposited on the platina. When the quantity of copper is small, there is merely a brown stain. This test is not so delicate as the iron test.

Objections to the tests.—Ammonia produces in a salt of nickel, a colour somewhat similar to that produced in a salt of copper; but ferrocyanate of potash precipitates a salt of nickel of a pea-green colour, a reaction very different to that produced on a salt of copper. There are no objections to the use of the ferrocyanate of potash as a test for copper. In an *organic* liquid containing no copper, I have, however, seen a pink-red colour produced by this salt, but the liquid tests here described should not be applied to solutions of the salts of copper in organic liquids. To the action of the third test, when

taken by itself, there are many objections; but these are entirely removed by the application of the other tests. The action of iron and of zinc and platina is peculiar; it is true that there is one other metal of a red colour like copper, namely, titanium: but this is not precipitated by iron or zinc and platina in its metallic state. We may now briefly advert to the specific characters of the different salts.

Sulphate of copper. (Blue vitriol. Roman vitriol. Blue stone.)—This salt is met with in rhombic masses, transparent, and of a rich blue colour. When reduced to powder it is nearly white, but becomes again blue on melting or dissolving it. It is soluble in four parts of cold and two of boiling water, and is easily obtained in well-defined rhombic crystals by evaporating a small quantity of the solution on a slip of glass. The powder undergoes no change on adding sulphuric acid. Nitrate of barytes added to the solution, indicates the presence of sulphuric acid.

Ammonio-sulphate.—This forms a rich violet-blue solution, and is known from the sulphate by producing a green precipitate with a solution of arsenious acid. The sulphate is unaffected by a solution of arsenious acid. Ferrocyanate of potash gives the characteristic red-coloured precipitate when the alkali is neutralized by sulphuric acid.

Nitrate.—It is crystallized in prisms of a deep blue colour and very deliquescent,—extremely soluble in water, and the solution is not precipitated if pure, by nitrate of barytes or nitrate of silver. When the powdered crystals are mixed with tin filings and moistened with water, nitrous acid fumes are evolved. By adding carbonate of potash to the solution and filtering, nitrate of potash is obtained in the filtered liquid, and the acid may be thereby identified.

Chloride.—This is seen in deliquescent crystals of an emerald green colour.—It is very soluble in water, forming a deep green solution, if concentrated; but becoming blue when diluted. This diluted solution has the remarkable property of becoming green when heated to 212°, and again blue on cooling. It yields an abundant white precipitate with nitrate of silver insoluble in nitric acid, by which it is easily known.

The insoluble or partially soluble salts of copper, which may give rise to questions of poisoning, are the subacetate, subchloride, carbonate and arsenite. They possess these common characters,—that 1, when rubbed on a steel spatula with a few drops of diluted sulphuric acid, metallic copper is abundantly precipitated on the iron;—and 2, when dropped into a strong solution of ammonia, they acquire a rich violet blue colour.

Subacetate, diacetate. (Artificial Verdigris.)—There are several varieties of this salt, some of which are blue, and others green. Verdigris is partially soluble in water, as sesquibasic acetate; but if this be acidulated with acetic or muriatic acid, a solution is immediately obtained, to which the tests for copper may be readily applied. If a portion of the powder be heated in a reduction tube, a film of metallic copper is produced,—and acetic acid vapour escapes. Acetic acid is, however, readily discovered by boiling the powder in diluted sulphuric acid. Sulphate of copper is at the same time produced, which admits of a ready analysis.

Subchloride. (Oxychloride. Brunswick green.)—This compound is insoluble in water; but is easily dissolved by nitric or muriatic acid, and the acid solution will give all the reactions for copper. The simplest way of analysing this compound, is to boil it in caustic potash:—when black oxide of copper is separated. This may be washed, dissolved in an acid and tested, while the chlorine may be detected in the filtered alkaline liquid on acidulating with nitric acid and adding nitrate of silver. This test will also detect the chlorine in the nitric acid solution of the subchloride.

Carbonate.—This is a blueish green compound, which is produced in firm crusts, when copper, brass, or bronze is exposed at the same time to the action of water and air. It is often called *natural* verdigris to distinguish it from the subacetate or *artificial* verdigris. When heated on platina foil, carbonic acid is evolved, and black oxide of copper is left. It is insoluble in

water; but is dissolved by acids with effervescence, a character which distinguishes it from the other insoluble salts. The acid solution gives the usual reactions with the tests for copper.

A case of poisoning by this substance has been lately reported by M. Desgranges of Bordeaux. A man died in about six hours from the effects of an unknown quantity of this poison which he had taken. When first seen he was comatose, and there was great coldness of the extremities. There was neither vomiting, purging nor pain in the abdomen on pressure. On inspection, the œsophagus and stomach were covered with a green coloured substance. The larger extremity of the stomach was vascular; and the mucous membrane corroded in patches. The mucous membrane of the intestines, as well as the liquid contained in them, was green. Carbonate of copper was found in the stomach, and traces of that metal existed in the urine—none was found in the blood. (Med. Gaz. xxxi. 495.) It is remarkable that in this case, there should have been neither vomiting nor diarrhea. The poison seems to have acted more like a narcotic than an irritant.

VERDITER is said to be a mixture of carbonate and hydrated oxide of copper:—it is, however, more commonly hydrated oxide mixed with lime, potash and alumina. It is of a rich blue colour, which it owes to the presence of a small quantity of muriate of ammonia. The oxide of copper may be dissolved by diluted acids. This colour is largely employed in paper-staining; but we do not hear of accidents from its use.

ARSENITE OF COPPER. (SCHEELE'S GREEN.) This is a powerful poison of a green colour, the depth of which is great in proportion to the quantity of oxide of copper present. Its poisonous properties are chiefly due to the arsenic contained in it. It is insoluble in water, but soluble in ammonia and the acids. When very gently heated in a reduction tube, arsenious acid is sublimed in minute octohedral crystals. These may be dissolved in water and tested in the usual way—the residuary oxide of copper may be dissolved in nitric acid and tested. With charcoal powder, the arsenite gives, although with some difficulty, a ring of metallic arsenic: but its nature is easily determined by boiling it with diluted muriatic acid and a slip of metallic copper or copper gauze. Metallic arsenic is immediately deposited on the copper. There is another kind of green pigment much used, called SCHWEINFURTH GREEN.—This is a mixture of arsenite and acetate of copper. The presence of arsenic in this compound is easily detected by muriatic acid and metallic copper. The arsenite of copper has been placed among cupreous poisons, because it so closely resembles them in physical and chemical properties;—and the existence of arsenic in it, might be easily overlooked. On the whole, these salts of copper are seldom used as poisons; although so easy of access, that they are to be purchased without difficulty in any colour shop.

Copper in organic mixtures.—The oxide of copper is liable to be precipitated by certain organic principles, as albumen, fibrin and mucous membrane: but some of these organic compounds are easily dissolved by acids or even an excess of the cupreous salt. A portion at least of the salt of copper is, therefore, commonly held dissolved. In such cases, there is one peculiar character possessed by these liquids, i. e. they have a decidedly *green colour* even when the copper salt is in a far less than poisonous proportion. We first filter the liquid, and save the insoluble portions for a separate operation. We may use as a trial test, a needle—zinc and platina, or add to a portion, oxalic acid; the last gives a blueish white precipitate only when the copper is in moderately large quantity. If the needle be not coated with copper in the course of a few hours, it is certain that there is no detectable quantity of the poison present in the liquid. The needle experiment will answer in spite of the presence of a large quantity of organic matter; and a very small quantity of a salt of copper may be thus easily discovered in tea, coffee, porter or gruel, provided we take care to acidulate the liquid slightly with diluted sulphuric acid, before introducing the needle. The following is the result of an actual experiment: One-third of a grain of sulphate of copper was dissolved in water, and mixed with four ounces of thick gruel. Ammonia pro-

duced no effect on this liquid; and ferrocyanate of potash gave only a faint reddish brown discolouration. Two drops of diluted sulphuric acid were added to it, and a bright needle suspended in it by a thread. In twenty-four hours, the needle was covered with a distinct film of metallic copper. The quantity of copper salt here present, was less than the 6000th part of the solution. If the needle be rusty, this experiment will fail. The smaller the quantity of copper, the longer the time required for the result to follow.

If the copper salt be present in large quantity, the trial tests will indicate it immediately. We now destroy the viscidity of the liquid by diluting it if necessary; and pass into it a current of sulphuretted hydrogen gas in order to precipitate all the copper in the state of sulphuret. The black sulphuret may be collected, washed, dried and then boiled in equal parts of nitric acid and water for a quarter of an hour. Nitrate and sulphate of copper are produced and dissolved, a fact indicated by the liquid acquiring a rich blue colour, and some sulphur is at the same time separated. This liquid, when filtered, will give the usual reactions with the tests for copper.

I have also found the following a very expeditious and simple method of obtaining copper from organic liquids. Having filtered the liquid, let a portion of it be placed in a clean platina capsule or crucible. A few drops of diluted sulphuric acid may be added, and a slip of zinc foil introduced. Wherever the platina is touched by the zinc, metallic copper is deposited; and after having in this way coated the platina capsule, the surplus liquid may be poured off and the capsule well washed out. A few drops of nitric acid with a small quantity of water, may be used to dissolve out the metallic copper. In this way, a pure solution of nitrate of copper is obtained,—giving the usual reactions with ammonia, and, when the surplus acid is neutralized by an alkali,—with ferrocyanate of potash and polished iron. Copper, if in moderate quantity, may be thus separated from milk, gruel, porter, or the most complex organic liquids.

Copper in the tissues.—It may happen, however, that there is no poisonous salt of copper held dissolved in the liquid subjected to analysis,—a fact indicated by the entire want of action on polished iron. The oxide of copper may be intimately combined with some organic principles, or even with the mucous membrane of the stomach itself, and exist only in an insoluble form. It will then be necessary to cut up these substances, which commonly have a green or blue colour, and boil them for an hour in water containing one-sixth part of strong nitric acid. The acid liquid should be filtered, and evaporated to dryness; and if much organic matter be present, this should be destroyed by redigesting it in strong nitric acid, and again evaporating it to dryness. Water will now dissolve out any copper as nitrate, which may have been taken up by nitric acid. If even this process should yield no copper, the organic matter, thoroughly dried, may be incinerated with two parts of black flux in a crucible. By pulverizing this residue, then carefully rubbing it in a mortar with water, and decanting the liquid, granules of metallic copper may be obtained, which should be dissolved in diluted nitric acid, and tested in the usual way.

It has been objected to this last-mentioned process of calcination, that copper is contained as a natural constituent in most of the organs of the body, and the term *normal copper* has been applied to it. According to Sarzeau, this metal is also present in the incinerated residue of sugar, coffee, madder, wheat-flour and likewise in cheese. Blood, milk and other liquids of the body, in cases where no poisonous salt of copper has been taken, are said to have also yielded it. One chemist made a mixture of eggs, some strong coffee and bread and butter; he dried and incinerated the mass, and detected copper in the residue. The metal is said to have been found in bread, beef and mustard. Thus then, according to this view, copper exists naturally, not only in the organs of the human body, but likewise in some of the most common articles of food. It is, however, by no means improbable that copper may, in these cases, have been introduced accidentally during the analysis, and thus have led to an erroneous inference, especially as it was only found

in infinitesimal traces. Dr. Christison could not detect any portion of the metal in the animal fluids; and in some experiments on large quantities of oatmeal and bread, I did not detect the smallest portion of copper, although the tests perfectly answered when a cupreous salt was purposely added in minute proportion. MM. Danger and Flandin have more recently arrived at the same results, i. e. that neither copper nor lead enter into the composition of the healthy human body or of the food of man. (B. and F. Med Rev., Oct, 1844, 549.) M. Devergie takes a contrary view, but it appears to me that the evidence from facts is against him (Ann. d Hyg. 1845, i. 142.)

In a practical view an objection of this kind amounts to nothing; 1. Because in poisoning by copper, there would be very few cases in which all the chemical evidence rested on an incineration of the viscera:—such a case is very unlikely to occur; for chemical evidence is in general abundantly afforded by an analysis of a portion of the poisoned substance swallowed or of the contents of the stomach. 2. If the only chemical evidence were that derived from incineration, then this could afford no proof of poisoning, unless that fact were already sufficiently made out by symptoms, post-mortem appearances, and moral circumstances, in which case such infinitesimal proof might be very easily dispensed with. In a case of falsely imputed poisoning, it may be said that the detection of copper in a particular article of food, such as bread, would lead the medical jurist into error, since the discovery of the metal in the bread might bear out the imputation and inculpate an innocent person. This hypothesis does not appear probable;—the normal copper, said to exist in food, has not been found to form more than the 100,000th part of the food examined:—if the imputation of poisoning were well founded, and copper were discovered at all, the metal would be in infinitely larger proportion, so as to leave no doubt of its actual admixture.

M. Boutigny has pointed out that in the process of incineration, the copper may be concealed and withdrawn from the action of the tests, by the presence of iron in the acid liquid. He has therefore advised that this should be first got rid of by the addition of ammonia.

Copper, like other metallic poisons, has been discovered in the blood, organs and secretions, where its salts have been taken. Orfila has found the metal in the lungs, heart, liver, spleen, and kidneys, of animals poisoned by it; but he could discover no traces of it in the blood or urine. Wibmer, according to Sobernheim, detected copper in the liver of a dog to which he had for several weeks given small doses of the sulphate MM. Danger and Flandin have recently stated, that copper in these cases, is to be detected more readily in the bronchial secretion than in the urine. (Annales D'Hyg., 1843, 452.)

Quantitative analysis.—This is best determined by converting the salt of copper to the state of black oxide, every 100 parts of which, are equal to 312 of crystallized sulphate, and 392 of crystallized nitrate. If the cupreous salt be precipitated as sulphuret, this may be transformed to black oxide by digestion in nitric acid, and subsequent precipitation by potash.

The medico-legal history of poisoning by copper would be incomplete without some remarks on the action of certain *articles of food on this metal* when used for culinary purposes. This is a not unfrequent form of accidental poisoning, but we seldom hear of its terminating fatally. It results from the experiments of Falconer and others, that metallic copper undergoes no change by contact with water, unless air be present; when a hydrated carbonate will be formed mixed with peroxide. If the water contain any acid, such as vinegar, or common salt,—or there be oily or fatty matter in contact with the metal, then the copper is more rapidly oxidized, and the liquid or fat acquires a green colour. If the copper vessel be kept perfectly clean, and the food prepared in it, be allowed to cool in other vessels, there is not

much risk of its acquiring a poisonous impregnation:—nevertheless no acid, saline, or oily liquid should be prepared as an article of food in a copper vessel. (See Ann. D'Hyg. 1832, i. 102.) The preparation of fruits as preserves in copper vessels, is necessarily attended with some risk; for on cooling, a green crust is apt to form on the copper, just above the surface where the air and acid liquid meet. Some substances appear to be but little liable to this impregnation:—thus, coffee, beer, milk, or tea has been boiled for two hours together, in a clean copper vessel, without any portion of the metal being taken up by either of the liquids. (See Falconer on the Poison of Copper, 65. London, 1774.) Accidents of this kind are usually prevented by lining the copper vessel with tin; but in very large boilers this plan is not always adopted—cleanliness alone is trusted to, and this is a sufficient preventive where properly observed.

In the making of preserved *fruits* and vegetable *pickles*, the salts of copper (blue vitriol) are sometimes used for the purpose of giving a rich green colour. Many of the green pickles, sold in shops, are thus impregnated with the vegetable salts of this metal, to which they owe their grass green colour. If the fruit or pickle be placed in a solution of ammonia, and copper be present, the substance is speedily turned blue. The iron test is, however, more delicate. The quantity of copper contained in such articles, may not be sufficient to produce fatal effects; but serious symptoms of gastric irritation are sometimes produced, and in very young subjects, these may assume an alarming character. (See Falconer, 87.)

A few years since, a fraudulent practice existed on the continent, of mixing sulphate of copper with the dough of *bread*, in order, as it was said, to accelerate the panary inflammation. The quantity of cupreous salt used was small, but still it was a noxious adulteration. (Ann. D'Hyg. 1830, 342; 1831, 338.) I am not aware that this practice has extended to England.

Accidental poisoning by copper has occurred from the use of what is called *German silver*, but which should rather be called *white brass*, as it is an alloy of copper and zinc with nickel. Some specimens of this alloy contain fifty per cent. by weight of copper. The following case of poisoning occurred in Paris in 1838. A lady, after having had eels for dinner, was awakened in the night by intense headache, followed by nausea, vomiting, and colic. These symptoms were removed, under proper treatment. Her physician ascertained that the eels had been cooked with butter and vinegar in an earthenware vessel, and he found the metal spoon, which was of German silver, presented on different parts greenish spots. Chemical analysis showed that a poisonous salt of copper had been thus accidentally produced:—a fact proved by polishing the spoon, and then placing it in a hot mixture of bread, butter, and vinegar. Half an hour after the mixture had cooled, green spots were perceived on it; and in twelve hours the spoon was quite green, as well as the butter in contact with it. It has been proposed to prevent this chemical action on copper and its

alloys by electro-plating them with silver, but Mr. Warington has found that the silver is deposited unequally like a spongy mass, thus allowing the acid liquid to penetrate through it. A galvanic action is thus set up which increases the chemical changes.

CHAPTER XVIII.

ON POISONING BY ANTIMONY, TIN, ZINC, SILVER, IRON, BISMUTH AND CHROME.

THERE are several preparations of these metals which require to be noticed as poisons, although it is extremely rare to hear of death being produced by any of them. Chaussier reports one case of alleged poisoning by the oxysulphuret of antimony, (Recueil de Mémoires, 322,) and a case of poisoning by the vapours of antimony is given in Ed. M. and S. J., lv. 265. Among the antimonial compounds, there are two which may be specially considered; namely, Tartar emetic and Butter of antimony.

TARTARIZED ANTIMONY. (TARTAR EMETIC. STIBIATED TARTAR.)—This substance, which is seen in the form of a white powder, or in crystals, is by no means so poisonous as it is often described to be. Forty grains have been given to an adult in twenty-four hours without causing serious mischief. Professor Forget of Strasburg has related the case of a robust man, aged forty, who, while labouring under acute rheumatism, took tartar emetic, first in the dose of eight grains, increasing it gradually to sixty, and then to seventy-two grains. He took this quantity without any disorder of the intestinal canal, or any other bad symptom. In the space of ten days, the man took without inconvenience three drachms of tartar emetic. (Med. Gaz. xxiv. 126.) Nevertheless other facts show, that this substance, in doses of from half an ounce to one ounce, or even less, must be regarded as an irritant poison; and one reason why the symptoms are often so slight from comparatively large doses, is owing to its possessing such violent emetic properties. This leads to the expulsion of the greater part of the poison from the stomach. A case is related by Dr. Lambert, where only four grains of tartar emetic gave rise to violent pain in the abdomen, vomiting and purging. The individual then fell into strong convulsions, which lasted half an hour. He became speechless, no pulse could be perceived, and the skin was quite cold;—in short, it was supposed he was dead. Stimulating frictions and cataplasms were employed, and he slowly recovered in about fourteen days. (Casper s Wochenschrift, xiii. 1241.)

It would appear from the observations of the late Mr. Goodlad (Provincial Journal) of Manchester, and Mr. Noble, that tartarized antimony, even in small doses, is liable to act as a poison on the young.

Mr. Wilton records four cases in which prostration and collapse followed the administration of ordinary doses of tartar-emetic to young children. Two of them were fatal. It should therefore be administered with great caution. A case, showing the importance of this remark in a medico-legal view, will be found in the Medical Gazette, vol. xvi. p. 520.

Tartar emetic appears to act more as an irritant than as a corrosive; but the symptoms which it produces, like those of all corrosive poisons, are generally immediate. Two deaths have recently been caused by this substance in England. In one a man, aged twenty-four was killed by a dose of three drachms taken by mistake: (Traill, 114.) and one or two fatal instances are reported by Orfila to have occurred in France. Our knowledge of its effects as a poison on man, are derived from the cases related by Orfila. In 1837, a trial took place on the Norfolk circuit for the administration of this substance with intent to murder; but there was a total want of proof: the tartar emetic was given to a child medicinally by the prisoner, an ignorant woman, without there being apparently any intention on her part to destroy it.

This substance is used in medicine both externally and internally. *Tartar emetic solution,* or VINUM ANT. POT. TART., contains one grain in half an ounce. It is exhibited in doses of fifteen drops to one drachm. Tartar emetic ointment contains one fifth of its weight of that substance.

SYMPTOMS.—A strong metallic taste is perceived in the mouth during the act of swallowing. There is violent burning pain in the epigastric region, followed by nausea, vomiting, profuse diarrhea and syncope. The pulse is small and rapid: the skin cold or hot, and the respiration painful. Death is preceded by vertigo, insensibility, great prostration of strength, and spasms of the extremities. Among the symptoms there has been great constriction in the throat, with difficulty of swallowing. The *quantity* actually required to destroy life is unknown. It will probably depend much on whether active vomiting and purging have been excited or not; for these symptoms have not been present in all cases. Doses of twenty, twenty-seven, and even sixty grains have been taken without destroying life; although alarming symptoms of irritation followed. In one case related by Orfila, a man aged fifty, took forty grains of tartar emetic and died in about four days. This was the only one out of five cases of poisoning by this substance which proved fatal. (Orfila, i. 447.) Dr. Beck mentions a case in which *fifteen grains* of tartar emetic, in solution, killed a child in a few weeks: vomiting and purging ensued, followed by convulsions and death. This, I believe, is the *smallest fatal dose* on record. Tartar emetic is said to have produced symptoms of irritant poisoning when applied externally to the skin, in the form of ointment as a counter-irritant. In a case where the skin was but little affected by the use of this ointment, nausea and sickness were produced, which disappeared when the use of the ointment was discontinued. Although it is very extensively used by medical practitioners, we never hear of cases of poisoning by it under these circumstances.

POST-MORTEM APPEARANCES.—In Orfila's case above-mentioned, the mucous membrane of the stomach and duodenum was reddened and covered with a slightly adhering layer of mucus. In a man who had taken forty grains of tartar emetic in a period of five days, and who then died from an attack of apoplexy,—the stomach was found much reddened and inflamed in irregular patches, the redness passing into a violet tint; but there was no ulceration of the mucous membrane,—the duodenum was in a somewhat similar state, and the small intestines were but slightly inflamed. In animals poisoned by this substance, it is common to find general inflammation of the alimentary canal.

TREATMENT.—This consists in promoting vomiting by the free administration of warm water, milk, or other diluents. The stomach-pump may also be used. Any vegetable infusion containing tannin, such as tea, decoction of oak-bark, or Peruvian bark, may be given. This principle combines with oxide of antimony, to form a compound insoluble in water; and if attended with no other benefit, it at least suspends the operation of the poison. This tannate of antimony is said to be inert; it is easily taken up by some vegetable acids. Should the decoction not be at hand, bark may be given either in the form of tincture or powder. Some cases are reported, in which this treatment appears to have been attended with the most decided benefit.

CHEMICAL ANALYSIS.—As a *solid*. In the state of powder,—1. Tartar emetic is easily dissolved by water,—it is taken up by fourteen parts of cold, and two of boiling water;—the solution has a faint acid reaction, and an acrid caustic taste,—it becomes decomposed by long keeping. It is insoluble in alcohol. 2. The powder dropped into hydrosulphuret of ammonia, is turned of a deep reddish-brown colour, and is thereby known from other poisonous metallic salts. 3. When heated in a reduction tube, it becomes charred, but does not melt before charring, like the acetate of lead. The metal is partially reduced by the carbon of the vegetable acid, and the decomposed mass has a greyish-blue lustre. No metallic sublimate is produced in this experiment, under any circumstances. 4. When boiled with muriatic acid and metallic copper, a grey deposit of antimony takes place on that metal. The colour is violet if the quantity be small. In *solution*. 1. On slowly evaporating a small quantity on a slip of glass, it will crystallize in tetrahedra. 2. *Diluted nitric acid* added to the solution, throws down a white precipitate, (subnitrate of antimony,) the other two mineral acids act in the same way; but as they precipitate numerous other metallic solutions, there are objections to them which do not hold with respect to nitric acid. The white precipitate thus formed, possesses the remarkable property of being entirely redissolved by a solution of tartaric acid:—it is also soluble in a large excess of nitric acid, so that if much of the test be added at once, no precipitate is formed. 3. *Ferrocyanate of potash* does not precipitate the solution, whereby tartar emetic is known from most other metallic poisons 4. *Hydrosulphuret of ammonia, or sulphuretted hydrogen gas*, produces in the solution, a reddish-orange-coloured precipitate,—differing in colour from every other metallic sulphuret. If the solution be very much diluted, the colour may somewhat resemble that produced in a solution of arsenic; but as the precipitate is produced in the antimonial solution by hydrosluphuret of ammonia, and this test does not affect a solution of arsenic, the difficulty, if any exist, is at once removed. The precipitated sulphuret of antimony produced by sulphuretted hydrogen, possesses the following properties; *a*, it is soluble in potash. (and also to a slight extent in a large excess of ammonia,) thus differing from the sulphuret

of cadmium; *b*, it is soluble in strong muriatic acid, thus differing from the sesquisulphuret of arsenic; *c*, when collected and dried it is decomposed by boiling muriatic acid, sulphuretted hydrogen is evolved, and a solution of chloride of antimony is thereby formed. In this way we may separate the sulphuret of antimony from that of arsenic; but muriatic acid added to a mixed liquid, will not prevent the precipitation of antimony with arsenic. 5. A small quantity of the solution of tartar emetic may be introduced into Marsh's apparatus:—on igniting the hydrogen gas, if antimony be present, it will burn with a yellowish-white flame evolving a white smoke. A black smoky sublimate is obtained on glass and copper—having rings of white or grey oxide of antimony; but commonly without any decided metallic lustre, unless examined through the reverse side of the glass. This deposit should be digested in nitro-muriatic acid; on evaporating to dryness, white oxide of antimony remains, which is turned of a red-brown colour when moistened with hydrosulphuret of ammonia. In this way, the smallest traces of the poison may be detected. Marsh's test serves to distinguish antimony from every other metallic poison except arsenic; and the differences between these two metals have been already fully described. The production of an iron-grey deposit on metallic copper by boiling the solution of tartar emetic with muriatic acid, distinguishes antimony from all other metals except arsenic and bismuth. On heating the copper in a reduction tube, a white milky film is obtained from the deposit, but no defined ring of octohedral crystals.

The foregoing tests, it will be observed, merely indicate the presence of oxide of antimony,—but this is in reality the poison which we have to seek,—the cream of tartar with which it is combined, being merely the vehicle; and in a case of poisoning this is no more the object of medico-legal research, than if it were the vehicle for the administration of arsenic or corrosive sublimate. It is besides well-known, that tartar-emetic is the only salt of the oxide of antimony in a soluble form, which is likely to be met with in medicine or chemistry. Should it be required to prove the presence of cream of tartar, this may be done by filtering a solution from which the oxide of antimony has been entirely precipitated by sulphuretted hydrogen gas. On evaporating this solution, the cream of tartar may be obtained.

Objections.—I know of no objections to the various tests recommended, when taken together. The action of sulphuretted hydrogen is peculiar. Marsh's test may be dispensed with, when the others answer; since this last is rather for the purpose of detecting small quantities of the poison as it may be locked up in the tissues, than for determining its real nature.

In Organic liquids.—Tartar emetic is precipitated by tannin in all its forms; but not readily by albumen or mucous membrane, therefore it may be found partly dissolved in the liquids of the stomach, provided no antidote have been administered. The liquids must be filtered; and as a trial test, a slip of paper may be dipped into it and then exposed to a current of sulphuretted hydrogen gas, or immersed in hydrosulphuret of ammonia. If the poison be in a soluble form, there will be an orange-red stain produced on the wetted portion of paper; this stain being immediately dissolved by caustic potash, but not readily by ammonia. Muriatic acid and copper will also serve as a useful trial test. If the tartar emetic be mixed with albumen, or the paper be allowed to become dry, before it is exposed to sulphuretted hydrogen, the stain is yellow, thus resembling that of arsenic. Sobernheim has observed a similar difference when tartar emetic is mixed with solution of gum. In analyzing the contents of the stomach, we might therefore be erroneously led to suspect the presence of arsenic, since tartar emetic is frequently given as a medicine. Having ascertained that antimony is present, sulphuretted hydrogen gas is passed into the liquid previously acidulated with tartaric acid, until there is no further effect. The sulphuret is collected, washed, and dried. If it be the sulphuret of antimony, it will have an orange-red or brown colour; and will, when dried, be dissolved by a small quantity of boiling muriatic acid with evolution of sulphuretted hydrogen. The boiling should be continued for several minutes. On adding this solu-

tion to a large quantity of water, a dense white precipitate of oxychloride of antimony will fall down. This is characteristic of antimony; if it be objected that nitrate of bismuth undergoes a similar change when dropped into water, hydrosulphuret of ammonia will easily enable us to distinguish the two metals; the antimonial precipitate is turned of an orange-red by that solution, while the bismuthic precipitate is turned of a deep black. Besides the white precipitate from antimony, is known from that of bismuth by its more ready solubility in tartaric acid. Dr. Turner recommended that the precipitated sulphuret of antimony should be reduced by heating it in a current of hydrogen; but there are some objections to this. Dr. Turner himself found that organic matter became precipitated with the sulphuret, and interfered with the metallic appearance after its reduction; and even supposing the metal to be obtained, it will require to be identified by certain chemical processes. The production of the chloride from the sulphuret, with its peculiar properties, is more expeditious and quite satisfactory. Antimonial wine may be thus readily analyzed.

Supposing that there is no antimony in solution, we take the solid substance left on the filter,—the mucus of the stomach or other matters, and boil them in water strongly acidulated with tartaric acid. The insoluble compounds of oxide of antimony are immediately dissolved by this acid. We now filter and pass into the liquid, sulphuretted hydrogen gas; sulphuret of antimony is precipitated if any of the poison be present, the vegetable acid not interfering with the action of the gas.

Antimony in the tissues.—If these processes fail, antimony may still be discovered in the solid tissues of the body. For this purpose, Orfila recommends, that the viscera should be thoroughly dried and added gradually to boiling nitric acid, until dissolved. Evaporate to dryness and carbonize. Boil the carbonaceous residue in muriatic acid with a little nitric acid. This converts the antimony to chloride,—a portion of which may be introduced into Marsh's apparatus, and tried for antimonial sublimates. If these be obtained, they may be tested in the way described. Another portion of the liquid may be evaporated on a slip of glass; and the white residue, if any, treated with sulphuretted hydrogen or hydrosulphuret of ammonia. Should antimony be present, it will be indicated by the formation of an orange-red sulphuret. By this process, Orfila has succeeded in detecting antimony in the urine, liver and other viscera, a clear proof that it is absorbed. He failed to discover it in the blood, or in any animal fluid except the urine. (Annales d'Hyg., 1840, 474.)

A medical jurist must remember that the discovery of tartar emetic in the contents of a stomach, is by no means a proof of its having been taken or administered as a poison; since it is frequently prescribed as a medicine, and often taken as such by persons of their own accord. We could only infer that it existed as a poison, or had caused death, when the quantity present was very large, and there were corresponding appearances of irritation in the alimentary canal. Any sulphuret of antimony may be separated from that of arsenic, by digesting the dried precipitate in muriatic acid; chloride of antimony is formed and dissolved.

Quantitative analysis.—The quantity of tartar emetic present in a liquid, may be determined by the weight of the washed and dried sulphuret of antimony: one hundred parts of the dried sulphuret (sesquisulphuret) by weight, are equal to 202·78 parts of crystallized tartarized antimony.

It is important, perhaps, in a medico-legal view to state, that arsenic has been discovered by Serullas, to exist in the common sulphuret of antimony, in the metal, and in the preparation called kermes. In the common sulphuret, it has been found in the proportion of from two to five per cent. It has been supposed that pharmaceutical preparations of antimony may be thus contaminated with arsenic; but it does not appear that tartar emetic, when well crystallized, contains any traces of that poison:—the mother liquor contains it, and sometimes the last crops of crystals which are obtained from the solution may hold a portion of arsenic.

Chloride of antimony. (Butter of antimony.) This is a highly corrosive liquid, varying from a light yellow to a dark red colour:—in the latter state containing generally a large quantity of iron. It is a powerful poison, but it is not often taken as such. Orfila mentions only one, and that a doubtful instance, which occurred nearly two hundred years ago. I have the accounts of three cases of recent occurrence, in two of which recovery took place, while the other was fatal. The following case was communicated to me by Mr. Henry Pearson. In 1836, a boy, aged 12, swallowed by mistake for ginger beer four or five drachms of a solution of butter of antimony. In half an hour he was seized with vomiting, which continued at intervals for two hours. There was faintness with general weakness, and great prostration of strength. Remedial means were adopted, and the next day the chief symptoms were heat and uneasiness in the mouth and throat, with pain in swallowing. There were numerous abrasions on the mucous membrane of the mouth and fauces, attended with slight fever, from which he quite recovered in about eight days.

The second case has been reported by Mr. Houghton, of Dudley: it occurred in 1841. In this instance, about a table-spoonful of the chloride of antimony was given by mistake for antimonial wine, to a boy aged ten. Immediately on drinking it, the boy seemed choked:—his features were set, and he was unable to speak for some minutes. He vomited freely,—gruel was given to him, which was rejected: he complained of great pain in his throat. Medical assistance was sent for, and about two hours after swallowing the poison, the child laboured under the following symptoms. The features were pale and collapsed, the eyes sunk,—the pupils dilated and inactive,—the skin cold,—the mouth filled with a thick tenacious transparent mucus,—nausea, vomiting,—pulse 80 and small, and breathing heavy. He was in a kind of stupor, from which he could, however, be roused to answer questions rationally. He felt a severe burning pain in the throat, extending to the stomach,—increased by deglutition. Under active medical treatment, these alarming symptoms were removed;—on the following day it was observed, that there were patches of a bright scarlet colour in the throat, with difficulty of swallowing. In the course of a few days the boy recovered.

The only fatal case which I have met with, was communicated to me by Mr. Mann of Bartholomew Close. An army surgeon swallowed, for the purpose of suicide, from two to three ounces by measure of chloride of antimony. About an hour afterwards he was seen by Mr. Mann. There was entire prostration of strength, with coldness of skin, and incessant attempts to vomit. The most excruciating griping pains were felt in the abdomen; and there was a frequent desire to evacuate the bowels, but nothing was passed. In the course of a few hours reaction took place, the pain subsided, and the pulse rose to 120. There was now a strong disposition to sleep, so that he appeared as if labouring under the effects of a narcotic poison. In this state he continued until he died,—ten hours and a half after he had swallowed the poi-

son. On inspection the interior of the alimentary canal, from the mouth downwards to the jejunum, presented a black appearance, as if the parts had been charred. In general, there was no mucous membrane remaining, either on the stomach or elsewhere; only a flocculent substance, which could be easily scraped off with the back of the scalpel, leaving the submucous tissues and the peritoneal coat. All these parts were so soft that they were easily torn with the fingers.

Chemical analysis.—If any portion of the chloride be left in the vessel, it may be tested by adding a few drops to a large quantity of water, when the whitish-yellow oxychloride of antimony will be precipitated: the supernatant liquid will contain muriatic acid, which may be detected by nitrate of silver. It has been already observed, that the only objection to this mode of testing, is, that the salts of bismuth are also decomposed by water; but the precipitate in this case is insoluble in tartaric acid, and is blackened by hydrosulphuret of ammonia; while in the case of antimony, it is soluble in that acid, and is changed to an orange-red by the hydrosulphuret. If the chloride contain much iron, it will be proper to separate the white precipitate, and wash it thoroughly with water, before adding the hydrosulphuret, or the presence of iron will conceal the orange-red colour. A piece of copper, when heated in a solution of chloride of antimony, is immediately coated with a layer of that metal of a grey colour, like arsenic. Solutions of tartar emetic and chloride of antimony are very differently affected by tests. Nitric acid precipitates the former, but not the latter. Ferrocyanate of potash has no effect on solution of tartar emetic, but it precipitates the chloride of antimony of a yellow-white; or if much iron be present, Prussian blue is abundantly thrown down. The chloride, as a corrosive, combines with the animal tissues. The antimony may be separated in such cases by boiling them in muriatic or nitromuriatic acid. In this way, the organic matter will be decomposed.

Poisoning by tin.—The only preparations of this metal, which require to be noticed as poisons, are the *chlorides*, or *muriates*, a mixture of which is extensively used in the arts, under the name of Dyer's Spirit. The salts may exist in the form of whitish yellow crystals; but more commonly they are met with in a strongly acid solution in water. They are irritant poisons; but so seldom used as such, that only one death occurred from them in England and Wales during a period of two years. They are decomposed by many organic principles; and milk, or albumen should be freely used in treating a case of poisoning by them.

Chemical analysis. Protochloride.—In the solid state it forms a milky solution with water, which disappears on the addition of muriatic acid. The acid solution in water is characterized by the following properties: 1. *Chloride of gold* gives a deep purple-brown precipitate, almost black. 2. *Bichloride of mercury*, in small quantity, gives a white passing to a grey precipitate of metallic mercury. 3. *Sulphuretted hydrogen* gas or hydrosulphuret of ammonia, gives a deep chocolate-brown precipitate, even in diluted solutions. 4. *Nitrate of silver* gives a white precipitate insoluble in nitric acid, thus proving the presence of muriatic acid or chlorine. Bichloride or permuriate. This is a highly acid liquid; it is not precipitated by chloride of gold or bichloride of mercury. It is known from other metallic poisons, except arsenic and cadmium, by giving a yellowish precipitate with *sulphuretted hydrogen* gas. It is known from an arsenical liquid, among

other properties, by this yellow precipitate being insoluble in ammonia, and from cadmium by the precipitate being insoluble in muriatic acid. When heated with black flux, it yields no metallic sublimate. The solution is also precipitated of a yellow-brown colour, by the hydrosulphuret of ammonia. Nitrate of silver will detect the acid. If we have to search for these poisons in the stomach, the better way will be to boil the solids in strong muriatic acid. This dissolves out in great part the oxide of tin. If this should fail, the viscera may be dried and calcined with three or four parts of black flux, when metallic tin will be obtained in the residue.

POISONING BY ZINC. (SULPHATE OF ZINC. WHITE VITRIOL.) This substance is ranked among irritant poisons, although it is certainly not very active as such. In doses of from a scruple to half a drachm, it is given as an emetic in most cases of poisoning; and as it frequently presents itself in the contents of the stomach in such cases, it is important that the medical jurist should be acquainted with its chemical properties. In order to show the slightly irritant effects of this substance, it may be stated that Dr. Babington of Guy's Hospital gave to a girl aged 17, thirty-six grains three times a-day for several weeks without any sickness or other untoward effect being produced. When the dose was raised to forty-two grains, which the girl continued to take for one week, she lost her appetite and felt much sickness (G. H. Rep. No. xii. p. 17). This must be regarded as a somewhat unusual case. Orfila refers to two instances, wherein sulphate of zinc was taken in a pretty large dose; but both of the patients recovered: in fact, in general, the powerfully emetic properties of this substance, interfere with its action as an irritant; since it is speedily expelled from the stomach by vomiting. Nevertheless, in four or five instances reported by continental writers, this poison has destroyed life; but there is, I believe, no instance recorded of its having operated fatally in England. It could scarcely be used as a poison by a murderer, since it possesses a strongly metallic taste, which would not be easily concealed by any kind of food. The SYMPTOMS produced by an over-dose, are pain in the abdomen and violent vomiting, coming on almost immediately, and diarrhea. POST-MORTEM APPEARANCES.—After death, the stomach has been found inflamed. The sulphate appears to act as a pure irritant; it has no corrosive properties.

TREATMENT.—Warm water, with milk, should be freely exhibited: it has been recommended to give albumen as an antidote, but it requires a very large quantity of this substance to precipitate the oxide of zinc. All infusions containing tannin may be usefully exhibited, such as oak-bark, or Peruvian bark, or these substances may be given in powder. A strong decoction of tea will equally answer. If the poison should have entered into the intestinal canal, a fact indicated by severe pain in the abdomen, enemata may be administered.

CHEMICAL ANALYSIS.—The pure sulphate is seen in white prismatic crystals, closely resembling in appearance, sulphate of magnesia and oxalic acid; from oxalic acid it is distinguished, by being fixed when heated on platina foil,—from the sulphate of magnesia, by tests applied to its solution. It is readily dissolved by water: this fluid taking up about one-third of its weight

at common temperatures. Analysis of the *solution*.—The solution in water has a slightly acid reaction. The following tests may be used for the detection of oxide of zinc: 1. *Ammonia* gives a white precipitate soluble in an excess of the alkali. 2. *Sesquicarbonate of ammonia*, a white precipitate, also soluble in a large excess of the test. 3. *Ferrocyanate of potash*, a white precipitate. 4. *Sulphuretted hydrogen* and hydrosulphuret of ammonia, a white milky precipitate, provided the solution be neutral, or nearly so. If the solution be very acid, sulphuretted hydrogen produces no effect whatever. These last-mentioned tests also throw down sulphuret of zinc from the precipitates dissolved by ammonia and its sesquicarbonate. 5. Sulphuric acid in the solution, is detected by the usual test, nitrate of barytes.

Objections.—Ammonia gives a white precipitate with numerous solutions, as with magnesia, the salts of lead, cadmium and the persalts of mercury; but it redissolves only the precipitate from zinc. Sesquicarbonate of ammonia precipitates many salts, white; but it is only the precipitate from zinc, which it has the power of redissolving. This test, by giving no precipitate with sulphate of magnesia, clearly distinguishes that salt from sulphate of zinc. Ferrocyanate of potash is a delicate test, since it will show the presence of the sulphate of zinc when forming only the 40,000th part of a solution: but it precipitates numerous other metallic salts white; and is therefore only a corroborative test. The action of sulphuretted hydrogen is perfectly characteristic of zinc; since this is the only metal, the salts of which are thrown down white by it. In order to precipitate it effectually, the oxide of zinc should be precipitated and redissolved by ammonia, and the gas then passed into the alkaline solution. The common white vitriol of commerce is in rough reddish white irregular semi-crystalline masses. When dissolved in water, the action of the tests is somewhat different, because this substance usually contains iron. Thus, oxide of iron is left on redissolving the precipitate given by ammonia and its sesquicarbonate; the precipitate with ferrocyanate of potash is blue or blueish-white, instead of white; and the sulphuret thrown down by the fourth test, is of a dark-brown colour. Among the common salts which might be mistaken for zinc in solution, is alum; for this last is precipitated by all the tests above mentioned, except sulphuretted hydrogen gas and ferrocyanate of potash. It strongly resembles a metallic solution, in being precipitated by hydrosulphuret of ammonia, owing to the alkali separating alumina; but the non-precipitation by ferrocyanate of potash, and the insolubility of the precipitated alumina in the ammoniacal tests, would easily distinguish a solution of alum.

In organic mixtures.—If the sulphate of zinc be dissolved, we may pass into the soiution, a current of sulphuretted hydrogen; the presence of zinc is immediately indicated by a milky-white froth.—the sulphuret may be collected, and decomposed by boiling it with muriatic acid. The white sulphuret of zinc is apt to conceal faint traces of arsenic, where the sulphate has been given as an emetic in cases of arsenical poisoning. Reinsch's test may then be used to detect the presence of that poison; the sulphuret of arsenic is soluble in ammonia, and may thus be separated from that of zinc; but a few drops of muriatic acid will answer better for this separation; this acid converts the sulphuret of zinc to a soluble chloride, but does not affect the sulphuret of arsenic. If too much muriatic acid be used, the necessary neutralization by ammonia produces so much muriate of ammonia as to prevent the action of the tests,—the zinc-precipitates being soluble in this salt. The analyst must remember that zinc sometimes contains traces of cadmium; and this has been known to give rise to a wrong suspicion of the presence of arsenic in zinc and its compounds.

Zinc in the tissues.—If the salt of zinc be decomposed, and we have to search for it in the mucous membrane of the stomach, this may be cut up and boiled in diluted nitric acid; if necessary, the nitrate may be then neutralized by ammonia, and thrown down as sulphuret by a current of sulphuretted hydrogen gas. The viscera may be also incinerated with flux, and the zinc procured in the metallic state.

QUANTITATIVE ANALYSIS.—The zinc should be converted to oxide, every one hundred parts of which are equal to three hundred and fifty-seven parts of crystallized sulphate.

CARBONATE OF ZINC. (CALAMINE.) This compound does not appear to have any poisonous action; and it would probably require to be given in large quantity to produce any effect. Carbonate of zinc is the white substance which is formed on the metal when long exposed to air and moisture. Its effects may become a subject of investigation as a matter of medical police; since zinc is now much used for roofing, and also in the manufacture of water-pipes and cisterns. (See Ann. D'Hyg. 1837. 281, ii. 352.)

CHEMICAL ANALYSIS.—The pure carbonate is a white powder, insoluble in water, although possessing a faint alkaline reaction. It becomes yellow when heated, and undergoes no change in hydrosulphuret of ammonia. It is dissolved with effervescence by diluted sulphuric acid; and in this state, the tests for zinc may be readily applied to the solution. CALAMINE is an impure carbonate destitute of poisonous action. It consists of carbonate of zinc, silicate of zinc and peroxide of iron, which gives it a red colour. Some specimens have been found to consist in great part of sulphate of barytes. One specimen, according to Dr. Thomson, contained eighty-eight per cent of sulphate of barytes, the rest consisted of oxide of iron, alumina and chalk. There was not a trace of zinc or lead in it. The *active* principle of the calamine ointment of the old pharmacopœias must therefore have been the *lard!*

CHLORIDE OF ZINC is a very soluble deliquescent salt; the chlorine is detected by nitrate of silver.

ACETATE OF ZINC —This is a white crystalline salt of zinc, but very little used. It may be mistaken for sulphate of zinc, especially as it often contains some of that salt. It is known by boiling it in diluted sulphuric acid, when the acetic acid is expelled and identified by its odour.

LACTATE OF ZINC.—Zinc has been lately used in making utensils for holding milk during the separation of cream. It is probable that some of this salt is here formed, as well as a combination of oxide of zinc with casein. I have been informed that milk and cream which were allowed to stand in such vessels, have given rise to nausea and vomiting. This practice would not be allowed under a proper system of medical police.

OXIDE OF ZINC.—This substance is not very active, but when taken for a long continuance, it may produce serious symptoms. The following singular case of slow poisoning by the oxide is reported in the Brit. and For. Med. Rev. No. xi. p. 221. A man, aged forty-five, wishing to treat himself for epilepsy, took twenty grains of oxide of zinc daily, until he had taken the enormous quantity of three thousand two hundred and forty-six grains! He was then seen by a physician; he was considerably emaciated,—his bowels constipated, the extremities cold, the legs œdematous, the abdomen tumid, the skin dry—and the pulse slow and scarcely perceptible. Under proper treatment he recovered. This substance is known by its becoming of a yellow colour when heated, and by its ready solubility in diluted acids, with the action of the tests for zinc.

POISONING BY SILVER. NITRATE OF SILVER. (LUNAR CAUSTIC.) —This substance, which is commonly met with in small sticks of a white or dark grey colour, is readily soluble in distilled water; in common water it forms a milky solution. It acts as a powerful corrosive, destroying all the organic tissues with which it comes in contact. There are at least two cases on record, in which it has proved fatal in the human subject:—one of these occurred in 1837-8. The particulars are unknown. The TREATMENT consists in the administration of common salt.

Chemical analysis.—The *solution* in water is commonly acid. 1. A slip of *copper* introduced into a small quantity, precipitates metallic silver. 2. *Muriatic acid* throws down a white clotted precipitate of chloride of silver, insoluble in nitric acid, but soluble in ammonia and the alkaline hyposulphites. 3. *Arsenite of ammonia* gives a yellow precipitate. 4. *Sulphuretted hydrogen*, and the hydrosulphuret of ammonia, a black precipitate. 5. The nitric acid is discovered by adding carbonate of potash, when the filtered liquid will be found to contain nitre: or by sulphate of narcotine, (antè, p. 86.)

Poisoning by iron.—It seems that, although the oxide and carbonate of this metal, may be given in very large quantity, without any serious effects resulting, yet some of its preparations act as irritants.

Sulphate of iron. (Copperas. Green vitriol.)—One death from this substance took place in 1837-8. It has been several times administered with malicious intention. It cannot, however, be a very active preparation; for a girl who swallowed an ounce of it, recovered, although she suffered for some hours from violent pain, vomiting and purging.

A singular case, which seems to show that this substance may really act through the skin, has been lately reported by Mr. Moore, of York. A healthy boy, aged fourteen, after having been employed in picking crystals from the vat, in which sulphate of iron was set to crystallize, was attacked with headache and sickness. He vomited several times, felt pains in the calves of his legs, and colicky pains in the abdomen. At the same time, his limbs became contracted. The boy had previously complained that the liquor of the crystals, into which he was constantly dipping his hands, had cracked his fingers. In the course of a week or ten days, these symptoms disappeared under treatment. (Med. Gaz. xxx. p. 351.) No other cause could be assigned for this singular attack, than the frequent contact of the hands with the saturated solution of the green sulphate of iron. I have known a similar dryness and cracking of the skin of the hands, produced by contact with a strong solution of sulphate of copper; and it is stated by Dr. Christison, that the dyers of Glasgow were attacked at one time, with troublesome sores on the hands, from the frequent immersion of them in a solution of bichromate of potash.

Chemical analysis.—This substance is generally met with in crystals of a sea-green colour. It is readily soluble in water. 1. *Ferrocyanate of potash* added to the solution, gives a blueish precipitate, becoming of a deep blue by exposure to the air. 2. *Sulphocyanate of potash* gives a reddish precipitate, which after a short exposure to the air becomes of a deep blood-red colour. 3. *Hydrosulphuret of ammonia* gives a black precipitate. 4. Nitrate of barytes will show the presence of sulphuric acid.

Muriate of iron. Tincture of sesquichloride of iron.—This is an acid solution of peroxide of iron with alcohol, of a red colour, much used in medicine. Dr. Christison relates an instance, where a man, by mistake, swallowed an ounce and a half of this liquid:—the symptoms were somewhat like those produced by muriatic acid. He died in about five weeks,—the stomach was found partially inflamed and thickened towards the pylorus. A case was reported to the Westminster Medical Society in November, 1842, where a girl, aged fifteen, five months advanced in pregnancy, swallowed an ounce of the tincture of muriate of iron in four doses in one day, for the purpose of inducing abortion. Great irritation of the whole urinary system followed; but this was speedily removed and she recovered.

CHEMICAL ANALYSIS.—The iron may be detected by the tests above-mentioned,—the muriatic acid by the use of nitrate of silver.

POISONING BY BISMUTH. (SUBNITRATE OF BISMUTH.)—This substance, in a dose of *two drachms*, caused the death of an adult in nine days. There was burning pain in the throat, with vomiting and diarrhea,—coldness of the surface, and spasms of the extremities,—also a strong metallic taste in the mouth. On inspection, the fauces, larynx, and œsophagus were found inflamed; and there was inflammatory redness in the stomach and throughout the intestinal canal. (Sobernheim, 335.) In a case mentioned by Dr. Traill, a man took by mistake *six drachms* of the subnitrate, in divided doses in three days. He suffered from vomiting and pain in the abdomen and throat but finally recovered. (Outlines, 115). These cases are sufficient to prove that a substance very slightly soluble in water, may exert a powerfully poisonous action on the human system.

CHEMICAL ANALYSIS.—This substance is commonly seen under the form of a white powder, or occasionally in semitransparent pearly crystals. The powder is blackened by hydrosulphuret of ammonia, in which respect it resembles a salt of lead. It is turned of a yellow colour passing to a deep chocolate brown, with iodide of potassium. It is scarcely soluble in water, but readily dissolves in nitric acid, and when this solution is added to a very large quantity of water, the subnitrate, if the liquid be not too acid, is again precipitated. In this respect it resembles only chloride of antimony; but it is known from this compound by the action of sulphuretted hydrogen, or hydrosulphuret of ammonia.

POISONING BY CHROME.—The only compound of this metal which requires any notice as a poison, is the BICHROMATE OF POTASH. This salt is extensively used in the art of dyeing; and one death is reported to have occurred from it in 1837-8, but the particulars are unknown. There is no doubt that it is an irritant poison, affecting also powerfully the nervous system. A case is reported in which a strong solution caused burning pain in the throat,—violent vomiting and death in five hours. There was considerable destruction of the mucous membrane of the stomach and small intestines. (Schneider's Ann. der S. A., i. 461.) In animals it has produced in small doses vomiting, diarrhea, paralysis, and death in a few hours. It appears, also, like some other metallic salts, to have a local action when in a state of concentrated solution; and thus it has been observed to produce extensive sores on the hands of dyers, owing to frequent contact with the liquid.

Well-observed cases of poisoning by this compound, which is now extensively used in the arts, are rare; and, therefore, the details of the following case communicated to the Medical Gazette, vol. xxxiii. p. 734, by Mr. Wilson of Leeds, are of great practical interest. A man, aged sixty-four, was found dead in his bed, twelve hours after he had gone to rest. He had been heard to snore loudly during the night, but this had occasioned no alarm to his relatives. When discovered he was lying on his left side, his lower extremities being a little drawn up to his body: his countenance was pale, placid, and composed; eyes and mouth closed, pupils dilated, no discharge from any of the outlets of the body, no marks of vomiting or diarrhea, nor any stain upon his hands or person, or upon the bed-linen or furniture. The surface

was moderately warm. Some dye-stuff, in the form of a black powder, was found in his pocket. On inspection, the brain and its membranes were healthy and natural; there was neither congestion nor effusion in any part. The thoracic viscera were equally healthy, as well as those of the abdomen, with the exception of the liver, which contained several hydatids. A pint of a turbid inky-looking fluid was found in the stomach. The mucous membrane was red and very vascular, particularly at the union of the cardiac extremity with the œsophagus; this was ascribed to the known intemperate habits of the deceased. In the absence of any obvious cause for death, poison was suspected, and on analysing the contents of the stomach, they were found to contain bichromate of potash; and the dye powder taken from the man's pocket, consisted of that salt mixed with cream of tartar and sand. It is remarkable that in this case there was neither vomiting nor purging. The salt does not appear to have operated so much by its irritant properties, as by its indirect effect on the nervous system. This, however, is by no means an unusual occurrence, even with irritants, far more powerful than the bichromate of potash. The *treatment*, besides emetics, in these cases should consist in giving carbonate of magnesia or chalk, mixed up in a cream with water.

Chemical analysis.—This is an acid salt, easily known from all the other metallic poisons, by its being in crystals of a deep orange-red colour. It is readily soluble in water, and the solution has the rich orange colour of the salt. It has an acid reaction. It may be identified by the following tests: 1. The solution is precipitated of a rich red colour, by *nitrate of silver*. 2. Of a bright yellow, by the *acetate of lead*. 3. Of a dingy green, by a current of *sulphuretted hydrogen gas*. Potash may be discovered in it by the action of chloride of platina.

This then concludes the history of the mineral irritant poisons. Some substances considered poisonous by toxicologists, have been omitted, because as yet nothing is known of their effects on the human subject. Those bodies only have been here treated, which have either proved fatal to man, or which, from their being widely diffused in common life, are very likely to give rise to accidental poisoning.

CHAPTER XIX.

ON POISONING BY THE VEGETABLE IRRITANTS.

The poisonous substances of an irritant nature, which belong to the vegetable kingdom are very numerous as a class; but it will here be necessary only to notice those which have either caused death, or given rise to medico-legal investigations. They are truly vegetable irritants.

Aloes. Colocynth. Gamboge. Jalap. Scammony.—These different substances which are used in small doses as medicines, are liable when taken in large quantities, to give rise to vomiting, purging, and other symptoms of irritation. Colocynth has occasioned death in several instances; in one case a teaspoonful and a half of colocynth powder destroyed life, and one drachm of gamboge, a medicine much used by quacks, has proved fatal to man. (Traill's Outlines, 150.) Aloes and colocynth mixed, are said to be the basis of a certain quack medicine, sold under the name of Morison's Pills. These have proved fatal in many instances from the exhaustion produced by excessive purging, owing to the large quantity

of these pills, taken in frequently repeated doses. Our knowledge of the symptoms and post-mortem appearances produced by these irritants, is, indeed, chiefly derived from the cases which have proved fatal under this pernicious treatment. In the seventeenth volume of the Medical Gazette, will be found four cases of this description. The most prominent symptom is excessive diarrhea, with the discharge of large quantities of mucus; the individual becomes emaciated and slowly sinks. In some instances, the symptoms are those of inflammation and ulceration of the bowels. In 1836, a man was convicted of having caused the death of a person by the administration of these pills; in this instance, the death of the deceased was clearly due to the medicine; and on inspection, the stomach was found inflamed and ulcerated; the mucous membrane of the small intestines was injected and softened; and there was the appearance of effused lymph upon it. An ingenious attempt was made in the defence to draw a statement from the medical witness, that the good effects of some medicines, invariably increased in proportion to the quantities taken !—this anti-homœopathic proposition was, however, very properly rejected. In all cases, it must be remembered, that these drastic purgatives may cause serious symptoms or even death, when administered to young infants, or to persons debilitated by age or disease; nor is it necessary that the dose should be very large for fatal effects to follow. The questions here will be, whether the medicine caused death, or whether it simply accelerated it.

Hicrapicra appears to be a popular aloetic compound, and one death is recorded to have been produced by this in 1837-8. In another instance, death was caused by taking aloes in nitric acid, in which case the mineral acid was most probably the destructive agent. A singular case occurred in Germany a few years since, wherein a medico-legal question was raised respecting the poisonous properties of aloes. A woman, aged forty-three, not labouring under any apparent disease, swallowed two drachms of powdered aloes in coffee. Violent diarrhea supervened, and she died the following morning, twelve hours after having taken the medicine. On inspection, the stomach was found partially, and the small intestines extensively, inflamed. There were no other particular appearances to account for death, and this was referred to the effect of the aloes.

Savin. (Juniperus Sabina.)—This is a well-known plant, the leaves or tops of which contain an irritant poison in the form of an acrid volatile oil of a remarkable odour. They exert an irritant action, both in the state of infusion and powder. They yield by distillation a light yellow oil on which the irritant properties of the plant depend. The powder is sometimes used in medicine in a dose of from five to twenty grains. This substance is not often taken as a poison for the specific purpose of destroying life; but this is occasionally an indirect result of its use, as a popular means for procuring abortion. In this way it appears to have proved fatal in one case in 1837-8. From the little that is known of its effects, it acts by producing vio-

lent pain in the abdomen, vomiting and strangury. After death, the œsophagus, stomach and viscera with the kidneys, have been found either much inflamed or congested. It has no action as an abortive, except like other irritants, by causing a violent shock to the system, under which the uterus may expel its contents. Such a result can never be obtained without placing in jeopardy the life of the woman; and where abortion follows, she generally falls a victim. On the other hand, the female may be killed by the poison without abortion ensuing. In May, 1845, I met with a case in which death had been caused by savin powder,—abortion having first taken place. Eight ounces of a green liquid were found in the stomach, which with the œsophagus and the small intestines was highly inflamed. The poison was easily identified by placing some of the minute portions of the leaves found in the stomach, under a powerful microscope. (Med. Gaz. xxxvi. 646.)

Croton oil.—This is an oil extracted from the seeds of the croton tiglium. It is a powerful drastic purgative, producing in a large dose severe diarrhea, collapse and death. A case occurred in Paris in 1839, where a man swallowed by mistake two drachms and a-half of croton-oil. In three quarters of an hour the surface was cold and clammy, the pulse imperceptible, respiration difficult, and the extremities and face were as blue as in the collapsed stage of cholera. In an hour and a-half diarrhea set in; the stools were passed involuntarily and the abdomen was very sensitive to the touch. The patient complained of a burning pain in the course of the œsophagus. He died in four hours after swallowing the poison. There was no marked change in the mucous membrane of the stomach!

Judging from the following case, which is rather one of veterinary than of medical jurisprudence, this oil appears to be an active poison. A veterinary surgeon administered as a medicine, fifteen drops to a horse. The lips of the animal became swollen, and the skin peeled off; the horse suffered evidently great pain, and after lingering a short time died. An action was brought by the owner of the horse at the Oxford Aut. Cir. 1838, for the recovery of its value. From the evidence then given, it seemed probable that the animal had really died from a very small dose of the oil, although it was thought that more was given, than was here alleged to have caused death.

Castor seeds.—Of castor oil itself nothing need be said. It is not commonly known that the seeds from which this oil is extracted, contain in the embryo a very active poison, and that a few of them are sufficient to produce violent purging and death. The following is an instance of poisoning by these seeds, the only one with which I have met. The deceased, aged eighteen, was the sister of a gentleman who was at the time attending my lectures at Guy's Hospital.

The deceased, it appears, ate about twenty castor-oil seeds; one of her sisters ate four or five, and another, two. This was on a Wednesday evening. In the night they were all taken ill. About five hours after the seeds were eaten, the deceased felt faint and sick; vomiting and purging came on, and continued through the night. On

the following morning, she appeared like one affected with malignant cholera. The skin was cold and dark-coloured, the features contracted, and the breath cold; the pulse was small and wiry; there was restlessness, thirst, pain in the abdomen, and she lay in a sort of drowsy, half-conscious state. Whatever liquid was taken, was immediately rejected, and the matters passed by stool, consisted chiefly of a serous fluid tinged with blood. She died in five days without rallying; the two other sisters recovered. On inspection, a very large portion of the mucous membrane of the stomach, was found abraded and softened in the course of the greater curvature. There was general vascularity of the organ, and the abraded portion presented the appearance of a granulating surface of a pale rose-colour; it was covered by a considerable quantity of slimy mucus. The small intestines were inflamed, and the inner surface of them was abraded.

The irritant poison resides in the embryo, and is not expressed with the oil, which is a mild purgative. The effects produced on the sisters who recovered, bear out the statement of Dr. Christison, that two or three of these seeds will operate as a violent cathartic.

Berries and leaves of the yew-tree. (Taxus baccata.) It has been long known, that the berries and leaves of the yew-tree are poisonous to cattle;—they act very energetically, and produce death in a few hours, sometimes without vomiting or purging. Perhaps, with propriety, this should be considered rather as belonging to the narcotico-irritant, than to the irritant class of poisons. It is stated by Dr. Percival that a table-spoonful of the *fresh leaves* was administered to three children of five, four, and three years of age as a vermifuge. Yawning and listlessness soon succeeded; the eldest vomited a little, and complained of pain in the abdomen, but the other two suffered no pain. They all died within a few hours of each other. An interesting case of poisoning by the *berries* of this tree, was published a few years since by Mr. Hurt, of Mansfield. A child aged three years and a-half, ate a quantity of yew-berries about eleven o'clock. In an hour afterwards, the child appeared ill, but did not complain of any pain. It vomited part of its dinner, mixed with some of the berries. A medical man was sent for, but the child died in convulsions before he arrived. On inspection, the stomach was found filled with mucus, and the half-digested pulp of the berries and seeds. There were patches of redness in the mucous membrane, and this was so much softened, that it could be detached with the slightest friction. The small intestines were also inflamed. It is uncertain whether the poison is lodged in the pulp of the berry or in the seed; but most probably in the latter. In the Registration returns for 1838-9 is one case of death from drinking an infusion of the leaves of the yew, (yew-tree tea,) and in the returns for 1840 one of the death of a female aged thirty-four, from eating the berries of the yew.

The elder (sambucus nigra). Dr. Christison states that the *leaves* and *flowers* of the common elder act as an irritant poison, having caused in a boy, severe inflammation of the bowels which lasted for eight

days. (Ed. Med. and Sur. Jour. xxxiii. 73.) The berries of this tree do not appear to possess, in the ripe state, any noxious properties. The following case of poisoning by the expressed juice of the *roots* is reported in the Med. Gaz. xxxv. 96.

A weakly woman, fifty-four years of age, who had been sick all day, and thrown up a quantity of greenish matter, which she regarded as bile, was persuaded by her husband to take two tablespoonfuls of the juice of the fresh elder root, which he himself had dug up, shaved down, and pressed. The woman soon after complained of severe pain in the abdomen. She was ordered some infusion of senna, but did not take it, as the bowels began almost immediately to act copiously. Next day the symptoms were those of enteritis, which proved fatal.

CAYENNE PEPPER is reported to have destroyed life in one case in 1837-8. The particulars are unknown. There is no doubt that in a large dose it would irritate and inflame the mucous membrane of the stomach and bowels.

OIL OF TAR.—This is a powerful vegetable irritant. In 1832, about ten drachms of it caused the death of a gentleman, to whom it had been sent by mistake for a black draught. The party who sent it, was tried for manslaughter, but acquitted.

MOULDY BREAD.—There is another more common article of food, namely, *bread*, upon which some observations have been lately made by toxicologists. In the Annales d'Hygiène, 1843, pp. 35 and 347, will be found communications on this subject from MM. Guérard, Chevallier, and Gaultier de Claubry. The changes which take place in the decomposition of flour and bread, and the production of various kinds of *mouldiness*, are here investigated, together with the effects of such bread upon the animal system. It would appear that in some parts of France the peasantry manifest no repugnance to the eating of *mouldy bread*; and that in many instances the practice appears to be attended with no ill effects. The nature of the mould produced, however, is subject to great variation, and it is not improbable, as M. Chevallier suggests, that in some cases a poisonous principle is actually developed. In two instances of children, who had partaken of mouldy rye-bread, symptoms resembling those of irritant poisoning, supervened. The countenance was red and swollen, the tongue dry, the pulse quick, there were violent colics, with pain in the head and intense thirst. Vomiting and purging supervened with a state of collapse, but the children eventually recovered. These symptoms were ascribed to the production of "*mucor mucedo*" in the bread. In 1829, alarming effects having followed from the use of a certain kind of bread in Paris, M. Barruel was called upon to determine whether or not any irritant poison had become accidentally intermixed with it. The bread was simply in a mouldy state; there was no trace of poison. It is unnecessary to enter further into this subject; the facts adduced, together with experiments performed on animals, show that bread, in a state of mouldiness, may not only produce symptoms of poisoning, but actually cause death; and as it is impossible to distinguish the noxious from the innoxious kind of mould, the use of all bread in such a condition should be avoided.

Even *fresh bread* may occasionally seriously affect the body. The *brown bread* of London has been known to produce vertigo, lethargy, and other unpleasant symptoms, indicative of an affection of the brain and nervous system. This has been ascribed, with some probability, to the "*lolium temulentum*" becoming accidentally mixed with the corn. Rye-bread is not much used in this country, but the accidental presence of the *ergot* might here, in some cases, account for the symptoms which have been observed. See Ann. d'Hyg., 1834, ii 179; 1835, ii. 240; 1843, i. 41, 347; Henke Zeitschrift der S. A., 1842, ii. 185; 1844, i. 286, ii. 215.

Other vegetable irritants might be enumerated, but I believe these are the principal which have given rise to medico-legal inquiries. The treatment of such cases must depend on the nature of the symptoms; the main object should always be to remove the poison either from the stomach or bowels, with as little delay as possible. The nature of the poison is commonly apparent from the circumstances; for these cases are generally the result of accident, if we except the substance Savin, which is sometimes criminally administered. These vegetable poisons are beyond the reach of chemical processes:—they are only to be recognized either by their physical properties, or by the botanical characters of the berries, seeds, or leaves.

CHAPTER XX.

ON POISONING BY THE ANIMAL IRRITANTS.

THERE are certain irritant substances belonging to the animal kingdom, which here require to be noticed, since they sometimes give rise to questions of poisoning. It is unnecessary to say anything about the poison of hydrophobia, or of the venomous reptiles and insects; since these subjects do not fall within the scope of the present work. The first and most important of the animal irritants is the blistering fly.

CANTHARIDES. (SPANISH FLY.)—This poison has been frequently administered either in the state of powder or tincture, for the purpose of exciting aphrodisiac propensities, or of procuring abortion. When taken in the state of powder, and in the dose of one or two drachms, it gives rise to the following SYMPTOMS:—a burning sensation in the throat, with great difficulty of swallowing,—violent pain in the abdomen with nausea and vomiting of bloody mucus;—there is also great thirst and dryness of the fauces, but in a few cases observed by Mr. Maxwell, salivation was a prominent symptom. As the case proceeds, pain is commonly experienced in the loins, and there is incessant desire to void urine, but only a small quantity of blood or bloody urine is passed at each effort. The abdominal pain becomes of the most violent griping kind. Diarrhea supervenes, but this is not always observed:—the matters discharged from the bowels, are mixed with blood and mucus. In these as well as in the vomited liquids, shining green particles may be

commonly seen on examination, whereby the nature of the poison taken, is at once indicated. After a time, there is often severe priapism, and the genital organs are swollen and inflamed both in the male and female. In one instance, observed by Dr. Pereira, abortion was induced, probably owing to the excitement of the uterus, from the severe affection of the bladder: for there is no proof that this substance acts directly on the uterus to induce abortion. With respect to the aphrodisiac propensities caused by cantharides,—these can seldom be excited on either sex, except when the substance is administered in a dose which would seriously endanger life. When the case proves fatal, death is usually preceded by syncope, vertigo and convulsions. The tincture of cantharides produces similar symptoms:—they are, however, more speedily induced, and the burning sensation and constriction of the throat and stomach are more strongly marked: it is often so severe as to render it impossible for the individual to swallow; and the act of swallowing gives rise to the most excruciating pain in the throat and abdomen. POST-MORTEM APPEARANCES. In one well-marked case of poisoning by this substance, the whole of the alimentary canal from the mouth downwards, was in a state of inflammation, as well as the ureters, kidneys, and internal organs of generation. The mouth and tongue seemed to be deprived of their mucous membrane. In another instance, where an ounce of the tincture was swallowed, and death did not occur for fourteen days,—the mucous membrane of the stomach was not inflamed; but it was pulpy and easily detached. The kidneys were, however, inflamed. The brain has been found congested, and ulceration of the bladder is said to have been met with. There are very few fatal cases reported, in which the appearances have been accurately noted; indeed, the greater number of those who have taken this poison, have recovered. Cantharides are sometimes described as a corrosive poison; but the substance appears to have no local action of a chemical nature. It is a pure *irritant*, and the effects observed are entirely due to irritation and inflammation.

The QUANTITY of this poison, required to produce serious effects, or to destroy life, has been a frequent subject of medico-legal inquiry. Dr. Thomson represents the medicinal dose of the powder to be from one to three grains. On a late criminal investigation one medical witness stated, that one grain was the maximum dose, but this is an understatement; according to Thomson it is *three* grains:—the dose of the London Pharmacopœial tincture is from ten minims gradually increased to one fluid drachm,—of the powder, from *one to two grains*. (Pereira, Mat. Med. ii. 1846.) Doses above this, whether of the powder or the tincture, are likely to be injurious, and to give rise to symptoms of poisoning. On a trial which took place at Aberdeen, in 1825, it appeared that a drachm of the powder had been administered: severe symptoms followed, but the person recovered. Dr. Dyce, the medical witness, said he had given ten grains of the powder at a dose as a medicine. In three cases, observed by Mr. Maxwell, a drachm of the powder mixed with six ounces of rum was taken by each person: they were robust, healthy negroes,—they suffered severely, but recovered in

about ten days :—in these cases, irritation of the urinary organs did not appear until after the men had been bled. The *smallest quantity* of powder which has been known to destroy life, is in the case of a young female, quoted by Orfila,—the quantity taken was estimated at *twenty-four grains* in two doses. She died in four days ; but as abortion preceded death, it is difficult to say how far this may have been concerned in accelerating that event. Her intellect was clear until the last. In one instance a man recovered after having taken twenty grains of the powder. (Ed. Med. and Sur. Jour., October, 1844.)

An *ounce* of the tincture has been known to destroy life. It was taken by a boy, aged seventeen, and he died in fourteen days. This I believe is the smallest dose of the tincture which has killed. In the following instance a similar dose produced only serious symptoms. A woman, aged twenty-nine, swallowed an ounce of tincture of cantharides. Some time afterwards, there was severe pain in the abdomen, increased by pressure : it became swollen and tympanitic. She passed in the night a pint and a half of urine unmixed with blood. In two days, the pulse became feeble and scarcely perceptible :—there was delirium with severe pain in the region of the kidneys and bladder :—the urine was continually drawn off by a catheter. It was more than a fortnight before she was convalescent. (Med. Gaz. xxix. 63.) Four drachms and even six drachms have been taken; and although the usual symptoms followed, the parties did well. The last case was the subject of a trial at the Central Criminal Court, in September, 1836. Six drachms of the tincture were administered to a girl, aged seventeen : the medical witness was required to say whether half an ounce was sufficient to kill, as also what proportion of cantharides was contained in an ounce of the tincture,—he said five grains. One ounce of the tincture, P. L., is equivalent to six grains of the powder; but considering that the principle *cantharidine* is the substance on which the poisonous properties depend, it is very likely that the tincture varies in strength according to its mode of preparation. A case is quoted by Pereira, from Dr. Hosack, (Mat. Med. ii. 1842,) in which it is said, six ounces of the tincture were taken by a man without causing dangerous symptoms! This must have been an extraordinarily weak preparation : and probably the insects from which the tincture was made, contained little or no cantharidine. The same writer mentions a case within his own knowledge, in which one ounce of the tincture caused serious symptoms.

Cantharides are sometimes taken in the form of blistering plaster. A case was lately reported to the Westminster Medical Society, in which a woman took a piece about the size of a walnut, in chocolate by mistake. In about an hour, vomiting and strangury supervened : this was followed by inflammation of the kidney. The woman speedily recovered. In another instance in which half an ounce of the plaster, containing two drachms of the powder, was taken, death took place in twenty-four hours. (Ed. Med. and Sur. Jour., October, 1844.) In the Registration returns for 1840, one case of death from cantharides is recorded, in a male aged 46.

It is proper to state that cantharides will operate as a poison, when applied externally to a wound or ulcerated surface. This substance will also act with fatal effects, when applied to a large surface of skin. In January, 1841, a girl, aged sixteen, was killed at Windsor, under the following circumstances. She was affected with the itch,—sulphur ointment was prescribed for her, but by mistake, blistering ointment was used. This was rubbed all over the body of the girl:—she was soon seized with the most violent burning pain,—the ointment was immediately washed off, but the cuticle came off with it. The girl died in five days, having suffered from all the usual symptoms of poisoning by cantharides.

TREATMENT.—When vomiting exists, this may be promoted by demulcent liquids: if it does not exist, emetics should be given,—the object being to dislodge the poison. The state of the throat will scarcely admit of the application of the stomach-pump. Oil was formerly regarded as an antidote;—but it has been found that this is a ready solvent of the active principle, and is therefore injurious.

CHEMICAL ANALYSIS.—Cantharidine is the vesicating, and at the same time the poisonous principle of the insect. It is a white solid crystallizable substance, insoluble in water; but soluble in ether, alcohol, the oils and caustic alkalies. Although water does not dissolve it in its pure state, it takes it up with other principles, from the powdered insect; and thus an infusion of cantharides is poisonous. It is very volatile and produces serious effects in the state of vapour. There are no chemical characters by which this principle can be safely identified, if we except its vesicating properties. Orfila has applied reagents to detect cantharidine in the tincture; but without success. It has been recommended to digest the suspected solid, or the liquid contents of the stomach evaporated to an extract, in successive quantities of ether,—to concentrate these ethereal solutions by slow evaporation, and then observe, whether the concentrated liquid produces vesication or not:—the medical jurist being expected in such cases, to make himself the subject of experiment. In this way, Barruel discovered cantharides in some chocolate. (Ann. d'Hyg. 1835, 455.) This mode of testing is somewhat uncertain, unless the quantity of poison be large; and the affirmative evidence which it yields is better than the negative: since we can hardly infer the absence of the poison, when we obtain no result. There is, however, no other mode of discovering cantharides in solution whether as tincture or infusion than this. The difficulty of extracting this principle may be conceived, when it is stated that, according to Thierry's experiments, which are the most perfect, the quantity of cantharidine contained in the poison, is only about the 250th part of the weight of the fly, so that it would require nearly half an ounce of the powder to yield one grain of cantharidine. The quantity required to produce vesication is unknown, but it is extremely small. Cantharides are most commonly taken in powder, and then we may easily recognize the poison by its physical characters. If the insect be entire or only coarsely powdered, there can be no doubt of its nature. However finely reduced, the powder is observed to present by reflected light, small golden green or copper-coloured scales. These are perceptible to the eye, and are very distinct under a common lens. It has been recommended to separate the particles of cantharides, by suspending the liquid or other contents of the stomach in warm water, when the insoluble powder will subside, and they may be collected and dried for examination. In an elaborate essay on this subject, (Ann. d'Hyg. Oct. 1842,) M. Poumet recommends that the suspected liquids, mixed with alcohol, should be spread on sheets of glass and allowed to evaporate spontaneously to dryness.—The shining scales will then

be seen, on examining by reflected light, either one or both surfaces of the glass. This experiment answers very well. He has also found that the particles, adhering to the mucous membrane of the stomach or intestines, might be easily detected by inflating the viscus, and allowing it to become dry in the distended state, taking care to attach to it a heavy weight, so that during the process of drying, all the folds of the mucous membrane may disappear. On cutting the dried membrane and opening it on a flat surface, the shining scales are perceptible. Physical evidence of this kind would not be of much avail for medico-legal purposes, unless there were concomitant evidence from symptoms and post-mortem appearances. In trials for administering, the analysis might be confined to the article administered; and the physical test is then applicable, since the powder is commonly given in very large quantity. There are many insects besides cantharides, which have wings of a golden green colour, and are not poisonous: yet such insects are not likely to be found in the state of powder in the human stomach. Mr. Poumet states that there are some cantharides which contain no cantharidine.

The evidence of the presence of cantharides, or of their having been taken, is necessary to support a criminal charge; for, however unambiguous the symptoms produced by this poison may appear to be in its peculiar effects on the generative and urinary apparatus, the medical jurist should be aware that similar symptoms may proceed from disease. An important case of this kind has been published by Dr. Hastings. (Med. Gaz. xii. 431.) A young lady was suddenly seized with vomiting, thirst, pain in the loins, strangury and considerable discharge of blood from the urethra: the generative organs were swollen and painful. She died in four days. She was governess in a family, and there was some suspicion that she had been poisoned by cantharides. The stomach and the kidneys were found inflamed, and the bladder also: this contained about two ounces of blood. There was no trace of poison: and indeed it was pretty certain from the general evidence, that none could have been taken.

Particles of cantharides may be detected in the viscera long after interment. Orfila has detected them after a period of nine months, so that they do not seem to be affected by the decomposition of the body.

The *doses* and *comparative strength* of the powder and tincture of Cantharides according to the London Pharmacopœia, have been already stated. (p. 209.) There are some other preparations, the strength of which it may be important for the medical jurist to know. The *Acetum Cantharidis* or Vinegar of Cantharides is used externally. It is equivalent to about one tenth of the powder—i. e., five ounces are equal to four drachms of powdered cantharides. The *Ceratum Cantharidis* contains one sixth, and the *Emplastrum Cantharidis* contains one half of its weight of the powder.

Poisonous food.—Certain kinds of animal food are found to produce occasionally symptoms, resembling those of irritant poisoning. In some cases this poisonous effect appears to be due to idiosyncrasy; for only one person out of several may be affected. These cases are of some importance to a medical jurist, since they are very likely to give rise to accusations of criminal poisoning. In the absence of any demonstrable poison, we must test the question of idiosyncrasy by observing whether more than one person is affected, and whether the same kind of food, given to animals, produces symptoms of poisoning; if, with this latter condition, several persons be affected simultaneously, we cannot refer the effects to idiosyncrasy; they are most probably due to the presence of an animal poison. Among the articles

of food which have given rise to symptoms of poisoning, we may first mention,

Poisonous fish. Muscles. Salmon.—Of all the varieties of shell-fish, none have so frequently given rise to accidents as the common muscle. The symptoms which it produces, are uneasiness and sense of weight in the epigastrium, sensation of numbness in the extremities, heat, and constriction in the mouth and throat; thirst, rigors, difficulty of breathing, cramps in the legs, swelling and inflammation of the eyelids, with a profuse secretion of tears, and heat and itching of the skin, followed by an eruption resembling urticaria. The symptoms are sometimes accompanied by vomiting, colic, and diarrhea. They may occur within ten minutes or a quarter of an hour; but their appearance has been protracted for twenty-four hours. There is generally great debility. These symptoms have proceeded from the eating of not more than ten or twelve muscles. Two cases, reported by Christison, proved fatal, the one in three, and the other in about seven hours. In general, however, especially where there is free vomiting, the patients recover. In the inspection of the two above-named fatal cases, no appearance was found to account for death. The treatment consists in the free exhibition of emetics. The poisonous action of muscles can neither be referred to putrefaction nor disease; nor in all cases to idiosyncrasy, since sometimes those muscles only have been poisonous which were taken from a particular spot; all persons who partook of them suffered, and a dog was killed to which some of them were given. From a case which occurred lately to M. Bouchardat, it would appear that copper is sometimes present and may be the cause of the poisonous effects. Two women were poisoned by muscles, and he found on analysis sufficient copper in the fish to account for the symptoms of irritation from which they suffered. (Ann. d'Hyg. 1837, 358.) Copper is not, however, present in all cases, and it is therefore probable that there is in some, if not in all instances, an *animal poison* present in the fish. *Oysters* and *periwinkles* have occasionally given rise to similar symptoms. *Salmon*, sold in the state of pickled salmon, or even *herrings* salted, may also act as irritants; this may be due to the fish being partially decayed before it is used. In 1834, two persons at Maidstone lost their lives from eating salmon of this description.

Cheese. Sausages.—These articles of food have frequently given rise to symptoms of poisoning in Germany, but there is, I believe, no instance of their having proved fatal in England. The symptoms produced by cheese, have been those of irritant poisoning. The nature of the poison is unknown. In some cases the poisonous property is undoubtedly due to a putrefied state of the curd. Again, it has been supposed, that the poison is occasionally derived from certain vegetables on which the cows feed. The symptoms, caused by the sausage-poison, are very slow in appearing; sometimes two, three, or four days elapse, before they manifest themselves—they partake of the narcotico-irritant character. This poison is of a very formidable kind. In the

Medical Gazette for Nov. 1842, there is an account of the cases of three persons, who had died from the effects of liver sausages, which had been made from an apparently healthy pig, slaughtered only a week before. The inspection threw no light on the cause of death. The poisonous effect is supposed to depend on a *partial* decomposition of the fatty parts of the sausages. It is said, that when extremely putrefied, they possess no poisonous properties!

Train oil.—I am not aware that this has acted as an irritant on man, but it has caused the death of cattle within a quarter of an hour, producing intense suffering and foaming at the mouth. After death the intestines were found inflamed. The oil was not pure train oil but a mixture of naphtha and fish oil. (Pharm. Journal, April, 1845.)

Pork. Bacon.—These common articles of food occasionally give rise to symptoms so closely resembling those of irritant poisoning, as to be easily mistaken for them. In some cases, the effect appears to be due to idiosyncrasy; but in others, it can only be explained, by supposing the food to have a directly poisonous action. The noxious effects of pork have been particularly shown by the cases published by Dr. MacDivitt. (Ed. Med. & Sur. Jour. Oct. 1836.) The difficulties attending these investigations, will be best illustrated by the following case:

A young man accused a woman, with whom he cohabited, and her mother, of having administered poison to him in tea, which he had taken three hours previously When seen by a medical man, there was acute burning pain in the epigastrium, with constant vomiting of a dark coloured liquid, containing half-digested food; there was a dry burning sensation in the throat,—the pulse was weak and faltering,—the extremities were cold, and a cold perspiration covered the face and hands. The accused were women of bad character, and it was thought that the symptoms were caused by poison; it was found, however, that they were really owing to some pork which the man had eaten at dinner; by the administration of emetics and purgatives they soon disappeared. The women had partaken of the same food without being affected: this, then, appears to have been a case in which the effects were due to idiosyncrasy. Five cases, precisely similar, are reported. In no instance, did death ensue, nor could anything peculiar be discovered in the physical properties of the food. The symptoms were observed to come on in from three to thirty hours after a meal, and the poisonous properties, if they may be so called, appeared to reside in the fatty parts of the pork.

With respect to *bacon*, instances of its exciting an irritant action are very rare; nevertheless, there seems to be no doubt that it may cause violent pain, vomiting, diarrhea, and even death. One fatal case occurred in this metropolis, in December 1836, and from the effects produced, many supposed that the bacon must have become accidentally impregnated with arsenic. There did not appear to be any ground for this opinion. Meat of any kind newly killed or partially decayed, may cause irritant effects, and even death. Thus, *veal* has been known to destroy life. From one case that has occurred, it appears to me probable, that *mutton* may exert a deleterious action.

In the spring of 1841, the following case was referred to me from a town in Oxfordshire. Four members of a family had made their dinner in their

usual health from part of a sheep, which had died from a disease then prevalent among cattle. The symptoms somewhat resembled those of irritant poisoning, accompanied by others, indicating an affection of the nervous system. One of the patients, a child, died in less than three hours, the others recovered. There was no poison discovered in the food, nor in the body, nor was any poisonous vegetable used at the meal. The effects could only be explained by supposing, that an animal irritant poison was in some unknown manner generated in the food. Guy's Hospital Reports, April 1843. See also Ann. d'Hyg. 1829, ii. 267, 1834, ii. 69.

There is no doubt that epizootic disease may be a frequent cause of rendering animal food, poisonous. Partial decay may also render unwholesome and injurious, the flesh of the most healthy animal. What the nature of the poison is, we are quite unable to determine. Liebig imagines that it is owing to the production of a fermenting principle, and that it operates fatally by inducing a kind of fermentation in the animal body. It has been said that the symptoms of irritant poisoning, produced by animal food, seldom appear until five or six hours after the meal. This may be generally true, but in certain instances it has undoubtedly happened that the symptoms came on in from a quarter to half an hour after the taking of the noxious food.

In a late number of the Edinburgh Medical and Surgical Journal, (July, 1844,) it is observed, in reference to the poisonous properties of the *flesh of diseased animals* used as food, that "in America there are certain regions, extending for many miles in length and some miles in breadth, on the herbage of which, if an animal feeds, its milk and flesh acquire poisonous properties, yet itself enjoys tolerable health. The disease which the use of the flesh or milk of the animals, fed on these districts, produces, is known over all America by the name of the milk-sickness or 'trembles.' All the infected spots occur west of the Alleghanies; and it is well known, that of the early emigrants whole communities, on account of the prevalence of this malady in a particular locality, which is generally distinctly circumscribed, were often compelled to seek another; and even at this day, those who venture within the boundaries of an infected district, are constrained, as a condition of their residence, to abstain from the flesh of the cattle living within the same limits, as well as from the milk and its preparations. It appears from the late report of Drs. Hosack, Post, and Chilton on this subject, that in some of these infected districts, the inhabitants, with a recklessness of human life which seems incredible, carry the butter and cheese which they themselves dare not eat to the markets of the towns west of the Alleghanies, and that thus there are frequently produced symptoms of poisoning and even death, for which the medical attendant cannot account, or he is induced to consider as some new or anomalous form of disease. From the same report, we learn that the cattle from these districts are sent in great droves over the mountains, but, in order to deceive the buyers as to the place whence they come, they bring them to New York by a southern route, and style them 'southern cattle.' The flesh of these animals produces, in those who make use of it, symptoms of aggravated cholera

morbus. The viscera of the animals are often found diseased, and the livers almost invariably so."

Owing to the symptoms of poisoning which have followed the use of such beef, butter and cheese, the American government caused a medical inquiry to be instituted into the matter; and it is probable that they will adopt the recommendation of the reporters, i e. prohibit its sale. In the event of this occurring, it has been suggested as not improbable, that the poisoned food might find its way into England, and, from its cheapness, be diffused among the poor. It would therefore be advisable, that practitioners should be on their guard, and note any suspicious circumstances that may arise. As we are without a system of medical police in this country, it is not likely that government will have it in its power to prohibit the sale of such food, until cases indicative of the serious effects produced by it, have occurred.

CHAPTER XXI.

NARCOTIC POISONS. HYOSCYAMUS. LACTUCA. SOLANUM. OPIUM.

The symptoms produced by this class of poisons, have been already described (page 13.) They are chiefly referrible to disorder of the nervous system, indicated by vertigo, stupor, coma and convulsions. The poisons belonging to this class are very few in number. Orfila enumerates them as follows: Opium, Hyoscyamus, Prussic acid, Lactuca and Solanum. He also considers that the Taxus baccata (yew) should be ranked among narcotics; but there is some difficulty in exactly defining the boundary of this class of poisons. The most important of the four narcotics are, *Opium* and *Prussic acid;* although some are now inclined to regard prussic acid as a narcotico-irritant poison. In many cases, it causes convulsions and in some instances, vomiting and redness of the mucous membrane of the stomach. The other narcotics will require but a brief notice.

Hyoscyamus niger. (Henbane.)—All the parts of this plant are poisonous, but especially the roots and the seeds; the odour of the fresh cut leaves is sufficient to produce vertigo, stupor, and syncope. Accidents have arisen from the plant having been eaten by mistake. Several cases of this kind are reported by Orfila, to whom we are indebted for nearly all that is known of the subject. (Tox. ii. 259.) The individual appears as if intoxicated, and suffers from delirium, coma or convulsions; vomiting takes place, and he recovers. Instances of this plant destroying life are very unusual. The tincture or medicinal extracts in large doses, would occasion similar symptoms. The active principle is a crystallizable body called *Hyoscyamine*. It cannot

be readily separated, nor when separated, is it easily identified by chemical characters. In poisoning by this and similar plants, the fact is usually made evident from circumstances. In a doubtful case, the botanical characters are all that we can trust to, in order to identify it. The proper dose of the tincture is from half a drachm to two drachms,—of the extract from five to ten grains.

LACTUCA.—The extract of the lettuce (LACTUCA SATIVA) is well known under the name of *Lactucarium*, or lettuce opium. It is in small irregular dry masses of a brown colour and with an odour identical with that of opium. It has a weak narcotic action resembling that of hyoscyamus. By the smell only, is it liable to be mistaken for opium. It is very insoluble in water, and after long boiling, it forms a brown turbid solution which gives a greenish tint with sesquichloride of iron. It therefore contains no meconic acid. On examining a good specimen I have not found any trace of morphia. Nitric acid gives a yellowish tinge to the decoction, as it does to most other vegetable solutions. It is bitter to the taste, which appears to be owing to the presence of a bitter principle called *Lactucin*, upon which its feeble narcotic properties probably depend. There are no tests for lactucarium, further than the opiate odour with the want of solubility and the absence of the other chemical characters of opium. The LACTUCA VIROSA yields also lactucarium, but in larger quantity than the LACTUCA SATIVA. (Traill.) The properties are identical, the extract in both cases having been found by Orfila to be poisonous. There is no fatal case reported of poisoning by *Lactucarium* in the human subject, so far as I have been able to ascertain.

SOLANUM.—The DULCAMARA or bitter-sweet, is a well known hedge plant. It is commonly called the *woody nightshade*. This plant does not appear to possess poisonous properties;—the shoots, the berries, and the extract have been taken or given in large quantities, without any serious symptoms resulting. Four ounces of the aqueous extract produced no effect on dogs. In one instance a decoction of the plant is said to have produced in a man dimness of sight, vertigo and trembling of the limbs,—symptoms which soon disappeared under slight treatment. The alkaline principle *Solanine*, when extracted, has been observed to exert a poisonous action. Orfila found that the extract of Solanum nigrum had a very feeble effect as a poison: and the fatal cases reported to have been caused by it, are perhaps properly referrible to belladonna, for which it may have been mistaken. The single death from Dulcamara reported in the Registration returns for 1840, may perhaps have been due to a mistake of this kind.

OPIUM.—This is a solid vegetable extract, sometimes taken in this state as a poison, but more commonly in solution in alcohol under the form of tincture. Its poisonous properties are due to the presence of

the alkali, *Morphia*, which exists in it in the state of a soluble salt, being combined with a particular acid, the *Meconic*. Opium contains a very variable proportion of morphia—the quantity varying from two per cent. in the Bengal variety, to about nine per cent. in some varieties obtained from the East Indies. According to some, good opium will yield from ten to thirteen per cent. of morphia. Dr. Ure states that it is difficult to procure more than seven per cent. The Turkey opium contains on an average about six per cent. according to the recent analyses of Mulder; but the best kinds of Smyrna opium contain thirteen per cent. (Brande, 1200.) This difference in the quantity of morphia contained in the drug may sometimes account for certain differences observed in the effects produced by particular doses. It is said that the poisonous properties of morphia are much diminished by extraction from the drug; thus, according to the per centage just given, about nine grains of opium are equivalent to half a grain of morphia; but it is well known that this dose of solid opium will produce a much more powerful effect than that quantity of morphia. Dr. Kelso, of Lisburn, doubts the correctness of this statement, from experiments made on himself. (Lancet, Sept. 1839.) There is no form of poisoning so frequent as that by opium and its various preparations. In two years, there were no less than one hundred and ninety-six fatal cases in England and Wales, forming nearly two-thirds of all the cases of poisoning that occur. One-seventh of these were cases of children poisoned by over-doses of opium or its compounds, and most of the others were the result of suicide or accidents; but it is calculated that *three fourths* of all the deaths from opium, take place among children *under five years of age!* This, however, forms but a small proportion of the actual number of cases; since there is no kind of poisoning, wherein recoveries are so frequent. It is not often that we hear of a trial for murder by poisoning with opium:—the drug being seldom selected by murderers except where the intended victim is a young child.

Solubility of opium in water.—The poisonous salt of opium, meconate of morphia, is soluble both in water, alcohol and acids. So far as I am aware no experiments have been performed to determine the quantity of *opium* taken up by water in the form of infusion. In November, 1843, a case of poisoning by opium was referred to me by Mr. T. O. Duke, of Kennington, in which this question arose. An ignorant nurse made an infusion by pouring hot water on powdered opium in a bottle, and gave, at short intervals, three teaspoonfuls of this infusion to a child aged about fourteen months, and it died poisoned by the drug in about eighteen hours. It was found that the infusion contained only 1·6 per cent. of solid matter, i. e. of the soluble part of the opium; and that the principal part of the meconate of morphia had been taken up, was proved by an infusion subsequently made, retaining only faint traces of that salt.

The results of some experiments on this subject were as follows;

Fifteen grains of finely-powdered opium were infused, for twenty hours, with six drachms of boiling distilled water. On examination, the filtered infusion was found to contain four per cent. of solid matter, i. e. of the soluble part of opium. In another experiment, opium sliced was employed with water in the same proportion. The quantity dissolved averaged, on several trials, from three to four per cent. depending on the proportion of water and the length of contact. By boiling the residue in each case, a further quantity of meconate of morphia was obtained, showing that an aqueous infusion, while it will not extract the whole of the meconate at once, will yet take up sufficient to render it actively poisonous to young children.

Symptoms.—The symptoms which appear when a large dose of opium or its tincture has been taken, are of a very uniform character. They consist in giddiness, drowsiness and stupor, succeeded by perfect insensibility, the person lying motionless as if in a sound sleep. In this stage, he may be easily roused by a loud noise, and made to answer a question; but he speedily relapses into stupor. In a later stage, when coma has supervened with stertorous breathing, it will be difficult, if not impossible, to rouse him. The pulse is at first quick and irregular, and the respiration hurried; but when the individual becomes comatose, the breathing is slow and stertorous, the pulse is then slow and full. The pupils are sometimes contracted, at others dilated. From cases which I have been able to collect, contraction of the pupils is much more frequent than dilatation. The expression of the countenance is pale and ghastly. Sometimes there is vomiting or diarrhea; and if this take place freely before stupor sets in, there is great hope of recovery. Vomiting is chiefly observed when a large dose of opium has been taken; and may be perhaps due to a mechanical effect of the poison on the stomach. Nausea and vomiting often follow on recovery, and when the case proves fatal, convulsions are sometimes observed before death. Convulsions are, I believe, very common in young infants poisoned by opium.

These symptoms usually *commence* in from half an hour to an hour after the poison has been swallowed. Sometimes they come on in a few minutes, especially in young children; and at others their appearance is protracted for a long period. As we might expect, when the drug is taken in the solid state, the symptoms are commonly more slow in appearing, than when it is dissolved in alcohol. Their appearance is also protracted if the stomach be full at the time: and it is said that intoxication has the effect of retarding them. (Christison.) In a case reported by Mr. Semple, (May, 1841,) one ounce and a half of laudanum was taken by a girl, aged nineteen. The symptoms did not appear until *an hour and a half* afterwards. There was drowsiness, but the patient was rational, and the pupils were contracted to the size of a pin's head, and did not dilate on removing the light. Under treatment the girl recovered. This is the longest case of protraction of symptoms which I have met with, where the dose was large.

This question is of some importance in relation to a power on the part of the deceased of performing certain acts indicative of volition and locomotion, after having swallowed a large dose of this poison. The narcotic effects may not come on, until the deceased has had ample time to attempt suicide in some other way. In March, 1843, a gentleman committed suicide at Hammersmith; he was found suspended by a silk handerchief; but it was shown that he had previously swallowed a large dose of laudanum. There was no doubt that he had died from hanging. In general, it must be allowed as at least possible, that a person who has taken a large quantity of this poison, may move about and perform many acts for one or two hours afterwards. (See case by Mr. Skae, page 221.)

It has been frequently observed, in cases of poisoning by this drug, that the individual has recovered from the first symptoms, and has then had a relapse and died. There is some medico-legal interest connected with this state, which has been called secondary asphyxia from opium, although there appears to be no good reason for giving to it this name. In December, 1843, a gentleman swallowed a quantity of laudanum, and was found labouring under the usual symptoms. The greater part of the poison was removed from the stomach by the pump; and he so far recovered from his insensibility, as to be able to enter into conversation with the surgeon; but a relapse took place, and he died the following night. It is not improbable that, in these cases, death may be occasioned by the accumulation of the poison, carried by the absorbents into the system.

Post-mortem appearances.—In a case which proved fatal in fifteen hours, examined at Guy's Hospital, a few years since;—the vessels of the head were found unusually turgid throughout;—on the surface of the anterior part of the left hemisphere, there was an ecchymosis, apparently produced by the effusion of a few drops of blood. There were numerous bloody points on the cut surface of the brain:—there was no serum collected in the ventricles. The stomach was quite healthy. This may be taken as a fair example of the post-mortem appearances in poisoning by opium. Extravasation of blood on the brain is, however, very rarely seen;—but serous effusion in the ventricles or between the membranes, is more common. The stomach is so rarely found otherwise than in a healthy state, that the inflammatory redness said to have been met with, may be regarded as probably due to accidental causes. When tincture of opium has been taken and retained on the stomach, increased vascularity in the mucous membrane, may be produced by the alcohol alone. From this account it will be seen that there is nothing but turgescence of the vessels of the brain, which can be looked upon as indicative of poisoning by opium, and even this is not always present. This condition of the brain, however, if it exist, can furnish no evidence of poisoning when taken alone, since it is so frequently found as a result of morbid causes, in otherwise healthy subjects. Fluidity of the blood is mentioned by Christison, as a common appearance in cases of poisoning by opium.

QUANTITY REQUIRED TO DESTROY LIFE.—The medicinal *dose* of opium for a healthy adult varies from half a grain to two grains. Five grains would be a very full dose. The effects of the drug depend on age, idiosyncrasy, state of health, and many other circumstances; as a suppository, five grains are often used, but I have known this quantity to produce alarming symptoms. In a case which occurred in London in 1838, a man aged forty-five, was killed by ten grains of solid opium: and in September, 1843, a woman, aged thirty-eight, was killed by eight grains of the drug given in two doses. (B. & F. M. R. October, 1844.) In another instance, a lady, aged twenty-nine, suffered from vertigo, numbness of the limbs, and other serious symptoms, when only *twenty drops* of the tincture were introduced in the form of enema, i. e. about one grain of opium. The same dose had been administered for six nights previously, without any serious effects following;—it might therefore be a question, whether the drug did not, in this instance, possess an *accumulative* power. She continued in a state of delirium for twenty hours, and the numbness of the limbs only ceased after forty-eight hours. This was an unusually small dose to affect an adult; but Dr. Babington informed me of the case of a lady who had taken five grains of Dover's powder, i. e. about half a grain of opium, and who suffered from stupor and drowsiness for three days; and Dr. Steinthal relates that one grain of opium in a clyster, administered to an adult gave rise to the most alarming symptoms. (Casper's Wochenschrift, Mai, 1845, s. 294.) These serious effects produced by small doses on adults, must be considered as exceptions to the rule: they appear to be due to idiosyncrasy or a peculiar susceptibility of the poisonous effects of opium in certain constitutions. It must not be forgotten, however, that they lead to one important inference in legal medicine, namely, that an adult may be killed by a dose of opium, which many, relying upon limited experience, would pronounce to be impossible. We have commonly no means of detecting or recognizing the existence of this idiosyncrasy in individuals prior to the fatal event. The *smallest dose of solid opium* which has been known to prove fatal to an adult, is described in a case communicated by Dr. Brown to Dr. Christison. *Four grains and a half* of opium mixed with nine grains of camphor, killed a man in nine hours with all the symptoms of narcotic poisoning. The *smallest fatal dose of the tincture* in an adult, which I have found recorded, is two drachms. This is a case reported by Mr. Skae. (Ed. M. and S. J., July, 1840.) The patient was a robust man, aged fifty-six;—he swallowed the tincture at ten in the evening, and died under the usual symptoms the following morning; the case thus lasting only twelve hours. The quantity actually swallowed, however, appears to be involved in some doubt; for it is subsequently stated (p. 160) that *half an ounce* of laudanum may have been taken. One fact was ascertained by Mr. Skae, of some medico-legal importance;—that the individual rose from his bed and moved about at least two, and probably three hours, after having taken the poison, showing

thereby that stupor had not supervened at that time. Opium as meconate of morphia, was detected in the stomach. In another case, in which the quantity taken was probably equally small, and ultimately proved fatal, the patient was able to converse cheerfully and readily with a neighbour two hours after she had swallowed the poison. In one case which I lately had to investigate, a woman died in twenty-two hours after taking *half an ounce* of tincture of opium by mistake for tincture of rhubarb. It is, however, necessary to observe, that very large doses of the tincture have been taken without proving fatal. At St. Thomas's Hospital, a few years since, two women were brought in, who had each taken an ounce of the tincture: they both recovered. Several similar cases have occurred at Guy's Hospital. In July, 1841, a man was brought in, who had swallowed one ounce and a half of the tincture. Vomiting came on, but he was not brought to the hospital until twelve hours after he had taken the poison. The stomach-pump was applied, and he recovered. Neither the matter then vomited, nor the liquid brought off by the instrument, contained any trace of opium or of meconate of morphia, although the quantity examined, amounted to six ounces. About the same time a woman was brought in, who had swallowed ten drachms of laudanum by mistake for tincture of rhubarb. Vomiting ensued, and she did well. It appears reasonable to attribute these recoveries from large doses to spontaneous vomiting, or to the treatment employed, but this explanation will not always be applicable. A case occurred to Dr. Young, (Med. Gaz. xiv. 655,) where a young lady took an ounce of laudanum in whiskey, and recovered in five days: there was no vomiting, and the cause of the symptoms was not even suspected until she had recovered from her stupor, and confessed that she had taken the poison. Another case occurred at the Westminster Hospital, in December, 1843, (Lancet, Dec. 1843,) in which a woman, aged twenty-five, was brought into that institution while labouring under the symptoms of poisoning by opium. She was perfectly comatose, the features devoid of expression, the lips purple, and the pupils contracted to the size of a pin's head. The eyes were everted and fixed. Sulphate of zinc and tartar emetic were given without effect, and the stomach-pump was not brought into use until about an hour after her admission. The contents of the stomach were entirely free from the smell of opium. The woman was kept roused, coffee was administered, and she recovered. It appears she had swallowed one ounce of laudanum, but at what time before her admission is not stated. It is difficult to say on what the recovery of this woman depended; for a very long time had elapsed before the contents were removed from the stomach, and then there was no trace of opium to be perceived by the smell. Opium, or morphia and its salts may undoubtedly exert an action through the skin whether this be abraded or not. Dr. Christison has quoted several cases in illustration of this point, pp. 723, 728. The following case of recovery from an excessive dose of opium was privately communicated to me a few years since by one of

my class. A medical student, after a hearty supper, at nine o'clock in the evening, swallowed *four ounces* of tincture of opium (P. L.) made by himself from opium procured at a respectable druggist's. He went to bed and slept until six o'clock the next morning, when he was awakened by a feeling of nausea. He then vomited freely; and, as he supposed, the whole of the contents of the stomach, smelling strongly of opium, were ejected. He perfectly recovered without feeling any other symptom than inability for muscular exertion. This is the largest dose which I have ever known to be taken without fatal consequences ensuing; and it is remarkable, that the opium should have remained so many hours on the stomach without causing serious symptoms and death.

Another circumstance connected with this subject it is important for a medical jurist to bear in mind, namely, that *infants* and young persons are killed by very *small doses of opium;* they appear to be peculiarly susceptible of the effects of the poison. Dr. Ramisch, of Prague, met with an instance of a child four months old, which was nearly killed by the administration of one grain of Dover's powder, containing only the tenth part of a grain of opium;—the child suffered from stupor and other alarming symptoms. The following case, occurred in June, 1832. Four grains of Dover's powder (containing less than half a grain of opium) were given to a child four years and a half old. It soon became comatose, and died in seven hours. Death was referred to inflammation of the throat, and the jury returned the usual unmeaning verdict of "Died by the visitation of God," but there was no doubt from the evidence that death was caused by the opiate medicine. Dr. Kelso also met with an instance where a child nine months old was killed in nine hours by four drops of laudanum, equal to *one-fifth part of a grain* of opium. It was much convulsed before death. A case is referred to in a late number of the Medical Gazette, in which two drops of laudanum, equal to the 10th part of a grain of opium, killed an infant. Instances of a similar kind are related by Dr. Christison. One is reported (Lancet, Feb. 1842) in which a child, two days old, was killed by a dose of a mixture containing one minim and a half of tincture of opium, equal to the 12th part of a grain. The child was seized with narcotism and coma, and died in fourteen hours. There are no appearances in the body under these circumstances to indicate the cause of death, and it is not very likely that the poison could be chemically detected when taken in so small a quantity. Dr. Merriman met with an instance where a child, a month old, was thrown into excessive stupor by a single drop of tincture of opium contained in a dose of mixture prescribed for it, equal to the 20th part of a grain. He met with two instances where death was caused by a small dose of Godfrey's cordial, which contains opium. In 1837 an inquest was held in this city on a infant, aged four months, which was killed by half a teaspoonful of Godfrey's cordial. It was properly stated by the medical witnesses, that the proportion of opium is not more than half a grain to an ounce in that mixture; and one professed himself ready to swear, that half a teaspoonful could not have caused the death of the child. It is ob-

vious, from what has been said above, that great caution should be exercised in expressing an opinion as to the quantity required to destroy the life of a young infant. We cannot measure the effects of opium on infants, by what we observe in adults: but still we find, that in spite of the accumulation of many facts, like those above related, there is often a disposition in medical witnesses to refer the death of a child in such cases to natural disease, because the quantity of opium taken happened to be insignificant. Some little allowance must be made on these occasions for professional bias. The nature of the symptoms, as well as the time of their occurrence after taking the medicine, and their aggravation after each dose, are the facts upon which a medical jurist should chiefly rely in forming an opinion. The post-mortem appearances in the body seldom furnish any information; and the poison is never likely to be discovered in the stomach, since it commonly exists only in minute fractional parts of a grain. Dr. J. B. Beck has lately published, in the New York Journal of Medicine, some excellent remarks upon the effects of opium on the infant subject. He shows that while this drug has a much greater effect on the infant in consequence of the greater impressibility of the nervous system, than on an adult, it is at the same time much more uncertain in its operation; and thus is liable to prove fatal in very small doses. Among the instances which he has accumulated, illustrative of the powerful action of the drug, he mentions one where a young child was narcotized by *fifteen drops* of paregoric elixir. This essay has been republished in the Medical Gazette, for March, 1844, vol. xxxiii. p. 767.

The quantity of this poison required to destroy life may present itself to a medical jurist as a question under another form; namely, whether a quantity, which, if taken at once would suffice to kill,—will prove equally fatal when administered at certain intervals in divided doses. This question is especially important in relation to the effects of opiate mixtures or powders on young children. There are, I believe, no facts on record, to enable us to return a precise answer to this question; but judging from the known operation of other poisons, and from one case of poisoning by opium, it appears to me certain when the intervals at which these divided doses are given, are so short that the patient has scarcely recovered from the effects of one, before another is administered,—that the poison may destroy life when the whole quantity has been taken, although each dose individually might be harmless. If a sufficient time has elapsed between the doses for the patient entirely to recover from the effects, there may be some doubt whether death would follow; although it cannot, I think, be denied that opium may possess an accumulative power. (See case, antè, p. 221, also Pharm. Journ., April, 1845.) This form of poisoning may be called chronic poisoning by opium. The whole quantity taken at once, might kill in a few hours; while, in divided doses, it might not prove fatal for two or three days. It need hardly be observed, in reference to this question, that when the quantity of poison taken at one dose, is not sufficient to kill, it is not likely that death will follow from the medicine being given in divided doses

PERIOD AT WHICH DEATH TAKES PLACE.—It has been remarked that most cases of poisoning by opium prove fatal in about from six to twelve hours. Those who recover from the stupor, and survive longer than this period, generally do well; but from some cases which have occurred, it would seem that there may be a partial recovery, and afterwards a relapse, antè, p. 220. The symptoms, however, generally progress steadily to a fatal termination, or the stupor suddenly disappears, vomiting ensues, and the individual recovers. Several instances are recorded of this poison having destroyed life in from seven to nine hours. One has lately occurred within my knowledge in which an adult died in five hours after taking the drug prescribed for him by a quack. Dr. Christison met with one which could not have lasted above five, and another is mentioned by him which lasted only three hours, while the shortest case reported, proved fatal in two hours and a half. (Beck. Med. Jur. 873.) It is possible that the drug may even kill with greater rapidity than this; but as a medico-legal fact, we are at present entitled to state, that it has destroyed life within the period above mentioned. On the other hand, the cases are sometimes much protracted. There are several instances of death in fifteen or seventeen hours. I have known one case fatal in twenty-two hours, and the longest authentic case lasted twenty-four hours. (Christison, 712.) In eight fatal cases of poisoning by opium reported by Dr. Beck,—the smallest quantity taken was one drachm,—the largest, one ounce and a half. The shortest time between the taking of the poison and death was eight hours, the longest twenty hours,—average time of six cases fourteen hours. (Dub. Med. Press, May, 1845.) In the same journal it is stated on Dr. Beck's authority, that out of thirty-nine fatal cases of poisoning by laudanum, the smallest quantity taken was *one drop*, the largest sixteen ounces. The shortest period for death was *two hours*, the longest *forty-eight hours;* average of twenty-three cases, twelve hours.

TREATMENT.—This consists in the removal of the poison by the stomach-pump, or in the case of an infant by a catheter, as speedily as possible. Should the case be far advanced, coffee, tea and other stimulants of the like nature, may be exhibited. Emetics are useful, where the stomach has power to act. Cold affusion has also been adopted, and in infants the plunging of the body into a warm bath and suddenly removing it from the water into the cold air, has been found a most effectual means of rousing it. Flagellation to the palms of the hands and soles of the feet or the back has been successfully employed. A common way of rousing a patient is to cause him to keep in continual motion, by making him walk between two assistants. Above all things, the tendency to fall into lethargy must be prevented; where this lethargy has existed, galvanism is said to have been found serviceable, as well as electricity in shocks or sparks to the head and spine, but whichever of these plans of treatment may be selected, no time should be lost. In a case where two ounces and a half of laudanum had been taken, and the patient refused to submit to the

usual treatment, an emetic was injected per anum and with succes. (Med. Gaz. viii. 12.) Artificial inflation of the lungs has also been found useful in the lethargic state. There is great doubt whether bleeding is beneficial. From cases reported by Mr. Bullock it would appear to be decidedly injurious. When there are signs of recovery, ammonia applied on rags to the nostrils, and frictions to the chest with the compound camphor liniment, will aid in restoring the patient. Cataplasms of mustard and cayenne pepper have been applied with advantage. The means above stated, variously employed, have been found to be eminently successful, but especially the removal of the poison by the stomach-pump. Out of many cases of poisoning by opium, brought to Guy's Hospital, but very few have proved fatal, even where the remedial treatment was applied late. The liquid drawn from the stomach sometimes smells of opium, but a good test to indicate the success of this plan of treatment, i. e. removal of the poison by the stomach-pump,—is to add to each successive portion of liquid drawn from the stomach and sufficiently diluted with water to make it clear, a few drops of sesquichloride of iron. If no red colour be produced there is no opium present. (See tests for MECONIC ACID.) Orfila has lately recommended *tannin* as an antidote in the form of galls, oak-bark, cinchona, or any astringent infusion. Tannin undoubtedly precipitates morphia, but it remains yet to be shown that the tannate of morphia is inert. The precipitate is soluble in very small quantities of any acid, even the acetic, which exists in the stomach; and it is not easy to understand, why, if arsenite of copper possesses poisonous properties in spite of insolubility in water, the tannate of morphia should not be also poisonous.

POISONING BY POPPIES.—The heads of the white poppy, grown in this country, contain meconate of morphia. They yield an inspissated extract called English opium, which is said by Mr. Hennell to contain five per cent. of morphia. The white poppy-heads, therefore, yield to water in the form of decoction, a poisonous salt capable of acting deleteriously on young children. Many cases of poisoning have occurred from the injudicious use of syrup of poppies, which is nothing more than a sweetened decoction of the poppy-heads. This syrup is said to contain one grain of extract (opium) to one ounce (Thomson.) The common dose of it for an infant three or four months old, is half a drachm,—for adults two to four drachms. (Pereira, ii. 1769.) There is great reason to believe, that what is sold by many druggists for syrup of poppies as a soothing medicine for children, is a mixture of tincture or infusion of opium with simple syrup; it is therefore a preparation of very variable strength. This will account for what appears to many persons inexplicable, namely, that an infant will be destroyed by a very small dose. In January, 1841, a child six months old is said to have died from the effects of less than half a teaspoonful of syrup of poppies bought at a retail druggist's. The narcotic symptoms were fully developed in three quarters of an hour. The syrup in this case probably consisted in great part of tincture of opium. Seven children

lost their lives by this syrup in 1837-8. In one of these cases, a teaspoonful and a half was given. Stupor came on in half an hour, and the child died the following day. A teaspoonful has been known to prove fatal to a healthy child. (Pereira, ii. 1769.) The following are cases of poisoning by the decoction of poppies. A woman boiled two poppy heads in a quarter of a pint of milk, and gave two small spoonfuls of this decoction to her child. In an hour, the child fell into a deep lethargic sleep,—the respiration became stertorous, and in ten hours it died. On inspection, the brain and its membranes were found congested. In a second case, a maid-servant, in order to quiet a child, gave it two teaspoonfuls of a decoction made by boiling one poppy head in a small pot of water. The child was found dead in the morning. The brain and its membranes were much congested; and the ventricles contained bloody serum. The seeds of the poppy were found in the stomach. It may be observed that the poisonous salt of morphia is generally considered to exist in the capsule of the poppy and not in the seeds; but Sobernheim mentions one or two cases of poisoning by the seeds of the plant (Tox. 500). For other cases see Henke Zeitschrift der S. A. 1844, i. 302. Extract of poppies acts like the decoction, but is more powerful. The dose for adults is from two to twenty grains.

GODFREY'S CORDIAL.—This is chiefly a mixture of infusion of sassafras, treacle and tincture of opium. The quantity of tincture of opium, according to Dr. Paris, is about one drachm to six ounces of the mixture. A case has been already related, in which half a teaspoonful probably caused the death of an infant. In 1837-8, twelve children were killed by this mixture alone. The explanation of this is, that the medicine is given in large doses by very ignorant persons.

DALBY'S CARMINATIVE.—This is a compound of several essential oils and aromatic tinctures in peppermint water, with carbonate of magnesia and tincture of opium. According to Dr. Paris, there are five drops of the tincture of opium to two ounces of this mixture; but in another formula it is stated that this tincture forms one eighteenth part of the liquid. (Med. Gaz. xxxi. 269.) Like most of these quack preparations, it probably varies in strength. An infant is reported to have been destroyed by forty drops of this preparation,—a quantity equivalent to little more than two drops of the tincture of opium. Accidents frequently occur from its use, partly owing to ignorance, and partly to gross carelessness in mothers and nurses.

LAUDANUM. (TINCTURE OF OPIUM.) The tincture of the London pharmacopœia is said to contain about one grain of opium in nineteen drops; and from this datum is commonly inferred the strength of those preparations of which it forms a part. I have, however, found by experiment that one hundred grains of tincture of opium carefully prepared according to the formula of the London pharmacopœia left on evaporation five grains of solid residue,—therefore it contained one twentieth of opium. Sixty minims of the same tincture weighed sixty grains and left three grains of solid residue. The medicinal dose of it for an adult, is from ten

drops to one drachm. It is liable to vary in strength. Pereira states that he has often procured morphia from the residue left after making the tincture. (ii. 1773.) When children are poisoned by opiate compounds, prescribed by druggists and others, the medical witness must be prepared for a very specious ex-post-facto defence; namely, that the particular tincture or preparation was not made according to the pharmacopœia, but according to the druggist's own formula. It is very well known that fractional parts of a grain of opium cannot be easily separated from any opiate preparation; and that by no chemical process can the exact quantity of opium in any mixture be determined, and therefore this appears to be a very convenient way of attempting to evade all kind of responsibility for the result. Thus if by mistake or carelessness one drachm of the tincture of opium be administered to a child and cause death with the usual symptoms of narcotism, and a medical witness proceed to infer from the known strength of the ordinary tincture, that at least three grains of opium were present in that dose and were sufficient to destroy life, he may be met with the answer that the tincture in question was a private preparation, and not made according to the pharmacopœial process. It need hardly be observed that if such a defence as this were admitted, no person could ever be convicted of poisoning under the circumstances. Perhaps the better rule would be for a witness to say whether there was or was not sufficient of the particular opiate preparation present, to cause death, without speculating upon the precise fractional quantities of the drug to which this might correspond. The symptoms will indicate whether they were or were not due to the medicine; and I fully believe that no judge or coroner, when there was a strong medical opinion in favour of poisoning, would permit an accused party to shelter himself under such an evasion as this. It would be equivalent to giving him the power of escaping all responsibility for malpractice. The preparation used would be taken to be of the proper pharmacopœial strength, unless the contrary were clearly made to appear. This kind of defence was set up in a well-marked case of poisoning by paregoric, in which Dr. Babington, Mr. M'Cann, and myself, were lately consulted, (G. H. Reports, April, 1844,) although there could be no medical doubt that death was caused by the poison, and a verdict was returned accordingly. The rate at which this poison (laudanum) is retailed to the public is as follows,—from half a drachm to two drachms for twopence, from two drachms to four drachms for fourpence, exceeding this quantity, eightpence and one shilling per ounce.

Paregoric elixir. (Compound tincture of camphor.)—This is a medicinal preparation of alcohol, opium, benzoic acid, oil of aniseed and camphor. Opium is the active ingredient, and of this, the tincture contains rather less than one grain in every half ounce (nine grains to five ounces). The following case of poisoning by paregoric occurred in March, 1843. A child between five and six years old, had had some cough medicine prescribed for it, at a

druggist's. The medicine consisted, as nearly as I could ascertain from a portion left in the bottle, of paregoric, having about from one fourth to one-half the strength of the pharmacopœial tincture. The child took about two-thirds of this mixture, given in divided doses, at somewhat irregular intervals, and died in about thirty-six hours. The quantity of opium in the portion of the mixture taken, was, judging by comparison with the usual strength of the tincture, from three-fourths of a grain to one grain and a quarter. The child became drowsy after each dose, and slept on one occasion for seven hours together. It was occasionally roused, and appeared sensible; but again relapsed into drowsiness on taking the medicine. A few hours before its death, it was found comatose with stertorous breathing and contracted pupils. On inspection, the whole of the organs were healthy, with the exception of the parietes of the ventricles of the heart, which were somewhat thickened;—there was no turgescence in the brain, nor effusion in the ventricles. The liquid contents of the stomach, yielded no trace of opium or an opiate. There was no doubt that the death of this child had been caused by an opiate. This was proved, 1, by the nature of the medicine taken; 2, the nature of the symptoms, which were aggravated after each dose; 3, the confirmed coma and stertor; and, lastly, the absence of every other cause to account for the rapid death under the circumstances. (G. H. Reports, April, 1844.)

It was a question here, how far a small quantity of opium in divided doses was likely to prove fatal to a child of this age? The answer given was to the effect, that although each dose might be individually harmless, the frequent repetition of the medicine, when the child had scarcely recovered from the effects of the former dose, might operate fatally. (See Pharm. Jour. April, 1845, p. 464.)

Another case where a child of seven months was killed by a teaspoonful (i. e. by a dose equal to one quarter of a grain of opium) is also reported. (Pharm. Jour. April, 1845.)

Dover's powder. (Pulv. ipecac. comp.) This is a preparation of opium, the fatal effects of which on children have already been adverted to. (p. 223.) The proportion of opium is one grain in every ten grains of the powder. A child has been killed by four grains—therefore by a quantity containing about two-fifths of a grain of opium.

The following is a case of poisoning by Dover's powder reported by Mr. Griffiths. (Medical Gazette, March, 1844.) About ten grains of Dover's powder were given by mistake to an infant seven weeks old, and it died in twenty-four hours afterwards. The following is an account of the post-mortem appearances. The countenance was placid, and the fingers of both hands were firmly contracted. On opening the abdomen, the colon was seen to be distended with flatus; the spleen, kidneys, and intestines were healthy; the liver gorged with blood; the stomach contained a very small quantity of colourless viscid matter. The inner coat was vascular; and at the great curvature as well as in other parts were patches of highly injected vessels. The lungs were gorged with blood; the upper lobes being infiltrated with a greenish serum. The pericardium was vascular, and contained about a drachm of fluid. The right auricle was empty; the left ven-

tricle contained some thin fluid blood, and a small coagulum. The sinuses of the dura mater were filled with dark coagula; the surface of the brain appeared covered by a complete network of vessels, distended with light coloured blood. On the surface of each posterior lobe of the cerebrum, slight extravasation had taken place. The brain was soft, and the difference of colour between the gray and white matter barely discernible. The vessels in the substance of the brain were gorged with blood, presenting, on section, a thickly-studded appearance—the spots of a deep dull red, and in many places coalescing. There was a small quantity of fluid in each lateral ventricle, and on the floor of each, were large distended blood-vessels. There was serous effusion on the surface and at the base of the brain, to the amount of about half an ounce. The contents of the stomach were carefully analysed, but neither morphia nor meconic acid could be detected. This case is interesting in several particulars. In the first place, it is surprising that so young an infant should have lived so long after taking a dose equivalent to one grain of opium. Making every allowance for the great vascularity of the brain in young subjects, it appears from the inspection, that the opium had here affected the organ, and caused a general congestion as well as effusion and slight extravasation, which last condition is somewhat rare in poisoning by opium. The non-detection of the poison in the contents of the stomach was sufficiently accounted for by the small quantity of opium in the Dover's powder, and by the length of time which the child survived. The opium contained in ten grains of Dover's powder is equivalent only to about the twentieth of a grain of morphia, and probably about the same proportion of meconic acid. It is extremely rare that opium is found in the stomachs of young children poisoned by small doses.

MORPHIA AND ITS SALTS.—These bodies act as poisons, but with more intensity than opium. Morphia, from its insolubility, is said to be less energetic than its salts; but the acids of the stomach would probably suffice to render it soluble and poisonous. According to Orfila, one part of morphia is equal in power to four parts of crude opium. Dr. Christison thinks, that half a grain is fully equal to two or perhaps three grains of the best Turkey opium. The medicinal dose of morphia or its salts, is stated to be from one-eighth of a grain to two grains. Morphia itself is seldom used,—the few cases of poisoning that are reported, have occurred from over-doses of its salts.

The SYMPTOMS and POST-MORTEM APPEARANCES produced by these substances, so far as can be ascertained, are much the same as in cases of poisoning by opium. They consist in dimness of sight, weakness, loss of consciousness, coma, stertorous respiration, and more commonly than in poisoning by opium, there are convulsions. The pupils have been found both contracted and dilated, and in some cases there has been great irritation with itching of the skin. These symptoms come on in from five to twenty minutes. Vomiting and diarrhea have also been met with—vomiting chiefly in those cases where the doses have been large, i. e. one grain and upwards—but in truth, well-observed cases of this form of poisoning are rare.

With regard to the QUANTITY required to dostroy life, this is a matter of some uncertainty, seeing that persons have recovered after taking considerable doses. The *muriate* of morphia has been given in doses of two grains every six hours without ill effects; but this was where it had been gradually raised from a quarter of a grain. Pereira

gave two grains at a dose without ill effects in a case of insanity, (ii. 1779.) I have been informed on good authority, that an adult who had taken this salt medicinally, was killed by a dose of three grains. Dr. Kelso suffered most formidable symptoms from taking only about half a grain of the muriate of morphia. (Lancet, Sept. 1839.) Dr. Christison mentions a fatal case of poisoning by ten grains of this salt, and although within half an hour, the stomach was completely cleared of the poison, the woman died in twelve hours. (727.) In one case a woman suffered from severe cerebral symptoms, by the application of one-fifteenth part of a grain of the muriate in two doses to the epigastrium, from which the skin had been previously removed by a blister. (Œsterreich. Med. Wochenschr. April, 1845.) There are equally extraordinary statements relative to the *acetate*. Mr. Headland attended an opium-eater, who was in the habit of taking seventeen or eighteen grains daily. In some of these cases, habit and certain diseased states of the nervous system, will explain the comparative impunity with which very large doses of these poisons may be taken. A case is reported by most toxicological writers of a young man who swallowed ten grains of the acetate, and shortly afterwards forty grains: he suffered from the usual symptoms, but ultimately recovered, although he had taken in the whole, fifty grains of the acetate of morphia on an empty stomach! An account of this case will be found in Schneider's Ann. der S. A., 1836, i. 455. In the Edinburgh Medical and Surgical Journal, (vol. xxxiii. p. 220,) a case is reported where a young man recovered in four days, after taking twenty grains of the acetate; but the most remarkable case of all is that reported by M. Bonjean, in which a young man, aged twenty-four, entirely recovered in about eight hours from a dose of *fifty-five grains* of acetate of morphia in an ounce of water. No symptoms of any importance manifested themselves until *an hour* after the poison was taken, and there was then simply vertigo with slight somnolency. Two hours after the occurrence, he still had the power to answer questions! In four hours deep coma supervened, but under copious bleeding and other treatment this gradually disappeared. (Ann. D'Hyg., 1845, i. 150.) It is difficult to say what is the *smallest quantity* of a salt of morphia that would destroy life. A child has been killed by ten grains of the sulphate given in the form of an enema, by mistake for sulphate of quinine. (Med. Gaz. iv. 220.) From an interesting case, which occurred in 1838, (Lancet, Nov.), there is reason to suppose that *half a grain* of the acetate of morphia, caused the death of a lady to whom it was administered as a medicine! She was at the time in a state of ill health. On the whole there is considerable uncertainty as to the operation of morphia and its salts as poisons; but we are, I think, notwithstanding the great anomalies which have been observed, justified in regarding it as rather the exception to the rule, that a person should escape, who has taken more than *two or three grains* of either salt,—that a far less quantity than this will kill a child, and may kill an adult. Symptoms of poisoning have certainly been pro-

duced by *one grain* of the acetate. The poisonous effects of these salts, as well as of all the other preparations of opium, may be equally produced through the medium of the skin, by introduction into wounds, or when injected as enemata into the rectum.

These poisons have been diligently sought for in the blood. M. Barruel states, that he detected morphia in the blood and urine of a person who had taken a poisonous dose of laudanum; but the result requires confirmation. Mr. Skae lately examined the urine of a person poisoned by opium, without detecting morphia, although the poison was discovered in the stomach.

Neither narcotine nor meconic acid appears to possess any poisonous properties. Narcotine is said to have acted as a poison, but in this case it was probably mixed with morphia. I have frequently found this mixture in specimens; and Dr. Christison states, that he has met with narcotine in morphia, a circumstance which may tend to explain the variable effects of this alkaloid in large doses. With respect to the other principles in opium, they require no notice in reference to legal medicine. Codeia is said to be poisonous; and one grain of this is considered to be equivalent to about half a grain of morphia. The common muriate of morphia of the shops is, according to Pereira, a compound muriate of morphia and codeia.

Chemical analysis. Opium. There are no means of detecting opium itself, either in the solid or liquid state, except by its smell and other physical properties, or by exhibiting a portion of the suspected substance to animals, and observing the effect produced. The smell is said to be peculiar, but a similar smell is possessed by lactucarium which contains neither meconic acid nor morphia. The *odour* is a good concomitant test of the presence of the drug, but it is not perceptible when the solution is much diluted. I found that half a grain of powdered opium dissolved in half an ounce of water lost its characteristic smell by a short exposure. The odour is decidedly volatile and passes off when an opiate liquid is heated; it also escapes slowly at common temperatures. Again, it may be concealed by other odours, or the drug may undergo some change in the stomach during life which may destroy the odour. The analysis in cases of poisoning by opium is limited to the detection of morphia and meconic acid.

Morphia and its salts.—Morphia is known by the following properties, 1. It crystallizes in fine prisms, which are white and perfect, according to their degree of purity. 2. When heated on platina, the crystals melt, become dark coloured and burn like a resin with a yellow smoky flame, leaving a carbonaceous residue. If this experiment be performed in a small reduction tube, it will be found that ammonia is one of the products of decomposition. 3. It is scarcely soluble in cold water; and it requires one hundred parts of boiling water to dissolve it:—the hot solution has a faint alkaline reaction. It is not very soluble in ether, thus differing from narcotine, but it is dissolved by forty parts of cold, and rather less than this quantity of boiling alcohol. It is solnble in oils and in the caustic alkalies (potash). 4. It is easily dissolved by all acids mineral and vegetable. 5. It has a bitter taste. In order to apply the chemical tests for morphia, it is better to dissolve it in a few drops of a diluted acid, which may be either the acetic or muriatic.

Tests.—The three best tests for this alkaloid, are the following. 1. *Nitric acid*. This, when added to a moderately strong solution of a salt of morphia, produces slowly a deep orange-red colour. If added to the crystals of morphia or its salts, deutoxide of nitrogen is evolved:—the morphia becomes

entirely dissolved, and the solution acquires instantly the deep red colour above described,—becoming, however, lighter by standing. In order that the effect should follow, the solution of morphia must not be too much diluted, and the acid must be added in pretty large quantity. The colour is rendered much lighter by boiling;—therefore the test should never be added to a hot solution. 2. *Permuriate of iron*, (sesquichloride,) or persulphate. Either of these solutions when saturated and neutralized, (by a small quantity of potash if necessary,) gives an inky blue colour in a solution of morphia. If the quantity of morphia be small, the colour is greenish:—the blue colour is entirely destroyed by acids,—it is also destroyed by heat: thus this test should never be employed with a very acid or a hot solution of a salt of morphia. It should be observed, that the blue given by the test in a solution of morphia is entirely destroyed by nitric acid, and replaced by the orange-red, so that the nitric acid will act through the iron test, but not vice versâ. In this way two tests may be applied to one quantity of liquid. 3. *Iodic acid*. Morphia in the solid state or in solution decomposes this acid, taking part of its oxygen and setting free, iodine. In order to make this evident, the iodic acid should be first mixed with starch; and a part of this mixture only, added to the suspected solution,—part being reserved to allow of a comparison. If the iodic acid be added to the solution of morphia without starch the liquid becomes brown and smells of iodine. If the quantity be very small, there is only a reddish or purple tinge, slowly produced:—if large, the dark blue iodide of farina is formed in a few seconds. This colour being destroyed by heat, the test must not be added to a hot solution. This test succeeds equally well with morphia or its salts when unmixed with organic matter; but the analyst must remember that the blue iodide of farina forms a colourless combination with a large quantity of starch: hence but little of this substance should be used, if the quantity of morphia be small.

Objections.—1. Nitric acid: this test gives an orange red or yellow colour with gallic acid and many kinds of organic matter, but this colour is not likely to be confounded with the deep red tint of morphia:—besides it is presumed that there is no organic matter present. It might be mentioned that according to some, pure morphia is not thus affected by nitric acid. I have tried many specimens, some of a pure kind; but have never failed to obtain this result. A more important objection is that other alkaloids are similarly coloured by it:—thus common strychnia from admixture with brucia, is turned of a scarlet colour; but does not readily dissolve in the acid,—small red lumps remaining in it for some time. Again, brucia is turned of a red colour, but is dissolved. In each of these cases, the red colour in the course of half an hour changes to a greenish brown, while that of morphia becomes of a light yellow. Narcotine is turned at once of a bright yellow colour by nitric acid, and therefore cannot be mistaken for morphia. Delphinia is said to give a similar colour, but I have found that this alkaloid forms with nitric acid, an iron-rust red solution, while the undissolved portions are of a dingy yellow colour. Veratria gives a light red tint. If the objections to this test be not thus removed, it may be observed, that none of the above alkaloids decompose iodic acid and set free iodine. 2. Permuriate of iron: this gives a blue tint with all solutions containing tannin or gallic acid, but this test could not with any propriety be used in an organic mixture;—or at least in such a case, no inference could be drawn from the production of a blue colour. 3. Iodic acid. This acid, I have found to be liable to spontaneous decomposition when long kept; and thus it should be separately tested with starch, before adding it to the suspected liquid. This will show whether any free iodine be present or not. Iodic acid is similarly decomposed by sulphocyanate of potash, sulphuretted hydrogen, cyanide of potassium, sulphurous and gallic acids, oxalic acid under exposure to light or heat, and other bodies; but as we are now supposed to be examining a pure alkaline solid dissolved for the occasion, these objections are of no moment. Sulphocyanate of potash gives a reddish colour with nitric

acid, but it forms a deep cherry red compound with the iron test, thus entirely differing from morphia. An important fact is, that no alkaloid yet discovered excepting morphia, possesses the property of decomposing iodic acid. These tests taken together, therefore, establish the presence of morphia. The objections to which one is exposed, if we except gallic acid, are removed by the application of the others; but gallic acid is easily known from morphia by its ready solubility in boiling water, and the acid reaction of its solution. If the salt of morphia be presented for examination in a state of solution, it should be evaporated to crystallization, and then redissolved in a small quantity of water. For an account of the comparative value of these tests, see G. H. Rep. Oct. 1844.

Meconic acid.—This is a solid crystalline acid, seen commonly in scaly crystals of a reddish colour. It is combined with morphia in opium, of which, according to Mulder, it forms on an average six per cent, (Brande, 1200); and it serves to render that alkaloid soluble in water and other menstrua. It is soluble in one hundred and twenty-five parts of cold water, and the solution reddens litmus. Many tests have been proposed for this acid: but there is only one upon which any reliance can be placed, namely, the *Permuriate* or *Persulphate of iron*. This test gives, even in a very diluted solution of meconic acid, a deep red colour,—and it is owing to the presence of this acid that the salt of iron causes a red colour in tincture and infusion of opium, as well as in all liquids containing traces of meconate of morphia. the effect of the iron test with morphia being counteracted by the presence of meconic acid. The red colour of the meconate of iron is not easily destroyed by diluted mineral acids, by bichloride of mercury, nor by chloride of gold, but it is by sulphurous acid and chloride of tin. It has been objected to the application of this test, that sulphocyanate of potash produces a similar colour with the salt of iron. This is certainly the case, but the red colour produced by the sulphocyanate, is immediately destroyed by a few drops of chloride of gold or bichloride of mercury. The concentrated alkaline acetates, also give a red colour with a persalt of iron and this is not removed by the metallic chlorides just mentioned, in which respect these salts resemble a solution of meconic acid;—but as they are neutral, and on boiling with an acid, acetic acid is immediately evolved, no difficulty can arise on this ground.

In organic mixtures.—Opium itself may be regarded as an organic solid, containing the poisonous salt which we wish to extract. It is not often that in fatal cases of poisoning by opium or its tincture, even when these are taken in large quantity and death is speedy, that we can succeed in detecting meconate of morphia in the stomach. It is probably removed by vomiting, digestion, or absorption:—certainly not always by decomposition; for I have discovered its presence in organic liquids, kept for twelve and fourteen months, and allowed to decompose spontaneously under the free access of air. In the case of a young woman, who died five hours after taking two ounces of laudanum, Dr. Christison did not succeed in detecting morphia by any of the tests. Other cases of a similar kind are mentioned by him. In two instances of poisoning, I have been unable to detect any meconate of morphia,—in one, the man died twenty-four hours after taking nearly two ounces of the tincture: in both of these the stomach-pump had been applied. The following case occurred in June, 1836. A woman swallowed an ounce and a half of laudanum in beer. In half an hour she was in a state of profound coma—she died in nine hours. None of the poison could be detected in the stomach, there was not even the smell of opium. In two cases, which occurred in 1844, one proved fatal in five and the other in twenty-two hours, I could not detect the least trace of opium either by the odour or by tests. In the last case half an ounce of the tincture had been taken. On the other hand, Mr. Skae detected traces in one instance, where probably only two drachms of the tincture had been taken. (See anté, p. 221.)

Process.—If the matter be solid it should be cut into small slices, if liquid evaporated to an extract, and in either case digested with distilled water and a small quantity of acetic acid for one or two hours at a gentle heat. The

aqueous solution should then be filtered, and acetate of lead added until there is no further precipitation. The liquid may then be boiled and filtered: meconate of lead is left on the filter while any morphia passes through under the form of acetate. The surplus acetate of lead contained in the solution, should now be precipitated by a current of sulphuretted hydrogen—the sulphuret of lead separated by filtration, and the liquid evaporated at a very gentle heat to an extract. On treating this extract with alcohol, the acetate of morphia may be dissolved out and tested. The meconate of lead left on the filter, may be decomposed by boiling it with a small quantity of diluted sulphuric acid; and in the filtered liquid, neutralized if necessary by an alkali, the meconic acid is easily detected by the iron test. This analysis requires care as well as some practice in the operator, in order that the morphia should be obtained in a sufficiently pure state for the application of the tests. Before resorting to this process, it is advisable to employ *trial tests*, in order to determine whether any meconic acid or morphia be present or not. The smell of opium may be entirely absent. The best trial tests are nitric acid and the permuriate of iron. These will give in the infusion or liquid, if it contain opium, the changes already indicated. In testing for meconic acid, it is advisable to dilute the organic liquid if coloured with a sufficient quantity of water, to render the production of a change of colour by the test, perceptible. But both of these tests are open to *objections*. Thus I have found that nitric acid as well as permuriate of iron added to a decoction of white mustard or a strong solution of sulphocyanate of potash (not saliva, for this is not reddened by nitric acid) produces effects very similar to those produced on a solution of morphia. The only difference is that the red colour of the meconate of iron is not destroyed by the bichloride of mercury, while the red colour of the sulphocyanate, is. Another remarkable circumstance to be observed is that iodic acid is decomposed by both of these liquids, so that a decoction of mustard closely resembles in the effects of all the tests, a solution of morphia. But circumstances may show that the liquids could have contained no mustard or saliva,—that on evaporation it left no residue of sulphocyanate of potash, and finally that it had the odour of opium. Dr. Pereira states that he has obtained from the stomachs of subjects in the dissecting-room (not poisoned by opium) a liquid which reddened the salts of iron. (Mat. Med. ii. 1741.) I have frequently applied the iron test to the contents of the recent stomach just so diluted as to allow any change of colour to be perceptible, without obtaining this result. On one or two occasions a greenish brown colour has been produced which could not be mistaken for the meconate of iron. Besides an occasional corrective here, would be that the red colour produced in an *opiate* liquid by the iron test is changed to a golden red by the addition of nitric acid: the only other liquid in which I have found this to occur was in a strong decoction of white mustard. Nitric acid produces a red colour like that of morphia with an infusion of nux vomica, but the iron test gives a green and not a red tint to this infusion. These tests may be usefully employed, with the precautions above-mentioned, to determine the presence or absence of opium in the contents of the stomach of a living person, ejected by vomiting or removed by the stomach pump.

In respect to this method of detecting the meconate of morphia in suspected liquids, it is proper to observe, that nitric acid will indicate the presence of morphia, and permuriate of iron the presence of meconic acid in infusions containing so small a quantity of opium as not to be precipitated by the acetate of lead. From experiments performed on the subject I have found it to be impossible to obtain a precipitate of meconate of lead with less than the 48th part of a grain of meconic acid, (= 0·34 grain of opium) in an ounce of liquid. One sixteenth of a grain of meconate of lead, will yield sufficient evidence by the application of the iron test. (G H. R. Oct., 1844.) These results were obtained by applying the tests to pure meconic acid dissolved in water. On dissolving powdered opium in water, I found that the soluble part of one tenth of a grain in one drachm of water, was clearly affected by nitric acid, but when mixed with one ounce of water it was not. In the last case,

however, meconic acid was distinctly indicated by the action of a persalt of iron; but the tenth of a grain of opium in an ounce of water gave with acetate of lead, no precipitate of meconate of lead, and the same quantity in one drachm of water gave only a faint precipitate which would scarcely admit of being collected. The meconic acid may be easily determined to be present by the iron test, in a liquid containing only one grain of opium: bnt it would be difficult in most cases to obtain so small a quantity of precipitate as this would yield, in a state to allow of the separation of the meconic acid. So nitric acid might indicate morphia, when the quantity of opium in a liquid amounted to one grain or less, in which case the proportion of morphia might vary from one-fourteenth to one-twentieth part of a grain. This would not admit of easy separation; hence unless we obtain a tolerably free precipitate of meconate of lead, insoluble in acetic acid, it will not be in our power to obtain the morphia and meconic acid separately.

There are no satisfactory means of determining the *quantity of opium* present in a suspected liquid. Dr. Ure has recommended that we should rely upon the depth of colour produced, on the addition of permuriate of iron to the liquid,—considering that the intensity of the red colour will indicate the presence of a large quantity of meconic acid, and consequently of meconate of morphia. The late analyses of Mulder have shown that this method is not accurate. The meconic acid does not bear any constant proportion to the morphia in opium. The only plan is to extract the morphia and weigh it. With respect to the Muriate and Acetate of morphia, these could only be obtained from an organic liquid by evaporating it to an extract, and digesting this extract in alcohol. In this case, the tests for morphia only could be applied:—the respective acids might, however, be detected by their appropriate tests.

Black drop. This is a preparation of opium, in which the morphia appears to be combined with acetic acid, and very little meconic acid is present. In the black drop, according to Pereira, verjuice, the juice of the wild crab, is employed as a menstruum instead of vinegar. The process might entirely fail to detect meconic acid in this liquid, hence we should treat the solution as an organic mixture, containing the acetate of morphia. The black drop is considered to have three times the strength of the tincture of opium. (Paris, Pharmacol. ii. 359.)

Battley's sedative solution is a watery extract of opium with a little spirit and less meconic acid than the common tincture (Pereira ii. 1772.) It is weaker than the black drop, but stronger than the tincture. The sedative solution appears to be an energetic preparation. Mr. Streeter stated at the Westminster Med. Soc. Dec. 1838, that he had known one drachm and a half of it prove fatal to a lunatic; and twenty minims of the solution destroyed the life of an old woman.

Other opiate preparations. It may be proper to state the medicinal doses and strength of some opiate preparations not mentioned in the foregoing pages. Confection of opium. *(Confect. opii.)* Contains one grain of opium in thirty six grains. The dose for an adult is from ten to thirty grains. Compound soap pill. *(Pil. Sap. Comp.)* Five grains contain one grain of opium. Dose three to ten grains. Compound pills of storax. *(Pil. Styracis Comp.)* The strength and dose are the same as in the compound soap pill. Compound chalk powder with opium. *(Pulv. Cretæ Comp. cum Opii.)* Forty grains contain one of opium. Dose five to thirty grains. Compound powder of kino. *(Pulv. Kino. Comp.)* Twenty grains contain one of opium. Dose five to twenty grains. Extract of opium. *(Extractum. Opii.)* Dose one quarter of a grain to three or four grains.

WINE OF OPIUM. *(Vinum Opii.)* This is said to have the same strength as the tincture, i. e. one grain of opium in nineteen (twenty) drops. Dose ten drops to one drachm. External applications. LINIMENT OF OPIUM. *(Linimentum Opii.)* This preparation contains one drachm of the tincture in half an ounce. ENEMA OF OPIUM. *Enema Opii.* In four ounces there are thirty drops of the tincture.

CHAPTER XXII.

POISONING BY HYDROCYANIC ACID. OIL OF BITTER ALMONDS. CYANIDE OF POTASSIUM.

HYDROCYANIC or prussic acid, owing to its rapid and unerring effects when taken even in comparatively small doses, is one of the most formidable poisons, with which we are acquainted. Most toxicologists consider it to be a narcotic poison, and in deference to this general opinion, I have still placed it under the section of narcotics: but from what will be hereafter stated, there is perhaps some reason to regard it as a narcotico-irritant. In general however its operation, as a sedative or narcotic, is so rapid that its irritant effects are not manifested. The pure or anhydrous acid requires no notice here; since it is not likely to be met with out of a chemical laboratory. The common acid is a mixture of this pure acid with water, and sometimes with alcohol. As it is sold in shops, it varies considerably in strength. I have found different specimens to contain from 1·3 to 6·5 per cent. of the strong acid; but we now commonly meet with two varieties. 1. The prussic acid of the London Pharmacopœia, containing about two per cent. (Phillips.) 2. Scheele's acid, containing from four to five per cent. In a case of poisoning which occurred lately, the acid which was sold for Scheele's was found to contain only two per cent! (Med. Gaz. xxxvi. p. 103.) In short there is no certainty respecting the strength of any two specimens sold as Scheele's acid except by direct analysis. The variable proportions of strong acid present, will in some cases explain the different effects produced by equal quantities of different specimens. On the continent, the acid is met with of a strength rising as high as from ten to twenty-five per cent. The price at which the acid is sold, is about two shillings an ounce.

Poisoning by prussic acid is commonly the result of suicide or accident. In 1837-8 there were twenty-seven cases of poisoning by this liquid, nearly all of which were the result of suicide. Within the last two years it has however acquired a fatal celebrity as a means of murder!

SYMPTOMS.—The time at which the symptoms of poisoning commence in the human subject is liable to great variation from circumstances not well understood. When a large dose has been taken, as from half an ounce to an ounce of the diluted acid,—the symptoms

may commence in the act of swallowing, or within a few seconds. It is rare that their appearance is delayed beyond one or two minutes. When the patient has been seen at this period, he has been perfectly insensible: there was convulsive respiration at long intervals, and he appeared dead in the intermediate time. The respiration has been described as slow, deep, and heaving or sobbing. The following case, communicated to me by my friend Mr. French, occurred in June 1837:—it presents a fair example of the effects of this poison in a large and fatal dose. A surgeon in large practice swallowed seven drachms of the common prussic acid. He survived about four or five minutes, but was quite insensible when discovered, i. e. about two minutes after he had taken the dose. He was found lying on the floor, senseless,—there were no convulsions of the limbs or trunk, but a faint flickering motion was observed about the muscles of the lips. The process of respiration seemed to cease for some seconds:—it was then performed in fits, and the act of expiration was remarkably deep, and lasted for a very long time. The deceased swallowed the poison while ascending the stairs; his body was found on the landing. The bottle had rolled some distance from him, and the stopper was lying in another direction.

Simon mentions a case in which an ounce was taken, and the symptoms were precisely similar. There was besides coldness of the hands and feet; but no pulse was to be felt. In such cases, i. e. where the dose is large, the breath commonly exhales a strong odour of the acid. Convulsions of the limbs and trunk with spasmodic closure of the jaws are usually met with among the symptoms. The finger nails have been found of a livid colour, and the hands firmly clenched.

When a small dose (i. e. about thirty drops of a weak acid) has been taken, the individual has first experienced weight and pain in the head, with confusion of intellect, nausea and a quick pulse; although these symptoms are sometimes slow in appearing. Vomiting has been occasionally observed, but it is perhaps more common to find foaming at the mouth, with suffusion or a bloated appearance of the face and prominence of the eyes. If death result, this is preceded by tetanic spasms, opisthotonos and involuntary evacuations. Vomiting is sometimes the precursor of recovery. (See case Med. Gaz. xxxvi. 103.) For an account of the symptoms produced by comparatively small doses see cases by Mr. Hicks, (Med. Gaz. xxxv. 893.) by Mr. Pooley (ib. p. 859.) and by Mr. Nunneley (Prov. Med. and Surg. Jour. Aug. 13, 1845, p. 517.) The last case was remarkable in several particulars: the individual swallowed it was supposed forty minims of an acid (at three and a quarter per cent.) and was able to give an account of his symptoms. He was conscious for some time after he had taken it, and he recollected experiencing the sensation of his jaws becoming gradually stiff and tight.

It has been stated that those who died from this poison, uttered a shriek or scream as the last act of expiration. Such a symptom has never, so far as I can ascertain, been observed in the human

subject. The cases in which persons have died from prussic acid, in the presence or within the hearing of others, are now very numerous. (See those of Mr. French, Mr. Hicks, Mr. Pooley, Mr. Godfrey, and Mr. Nunneley referred to in this chapter,) and in not one, was a shriek or scream observed to take place at any time! There was merely a gasping for breath, and a low moaning or sobbing noise, not more remarkable at the time at which insensibility supervened, than before. At the trial of Tawell this was poetically described by the counsel in defence, as "The death scream," as if it were a uniform or even a common accompaniment of poisoning by prussic acid! This opinion appears to have gained ground from a misapplication of the effects occasionally produced on animals to the supposed action of the poison on man. Mr. Mills informs me, that in the course of his duties as deputy-coroner for Middlesex, he has had occasion to make inquiries into this subject; and the result is, that from the evidence of witnesses at inquests, there is not the slightest reason to believe that a shriek or cry before death, is a symptom attendant on poisoning by prussic acid in the human subject.

If we contrast the effects of this poison with those of opium, we shall find the following general differences. In opium the coma comes on gradually, and is seldom seen until after the lapse of a quarter of an hour:—in poisoning by prussic acid, coma is almost instantaneously induced:—even in weak doses, insufficient to prove fatal, this symptom is seldom delayed beyond two minutes. Convulsions are met with in both forms of poisoning, but perhaps more commonly in poisoning by prussic acid:—with respect to the occurrence of this symptom, it is a fair question, whether medical jurists have not too readily adopted views, from experiments made on animals—not from observations on man: since in very few instances, where the dose of poison has been *large*, has the patient been seen alive. When the dose has been small but still fatal, convulsions have been sometimes observed. In poisoning by prussic acid, the case, if fatal, generally terminates in less than an hour: in poisoning by opium, the average period of death is in from six to twelve hours. This poison is said to act through a wounded portion of skin. Sobernheim mentions the case of an apothecary at Vienna, who died in an hour from the entrance of the acid into a wound in the hand, produced by the breaking of a glass vessel in which it was contained. It is also said to act through the unbroken skin; but this certainly does not appear to be the case with the common diluted acid. A question has arisen, whether this poison possesses an accumulative power, i. e. whether, after having been taken for some time, in a small dose without apparent mischief, it may not suddenly give rise to all the effects of poisoning, either by a repetition of the same dose, or by a very slight increase in quantity. Dr. Lonsdale, who has examined the effects of this acid, does not admit that it possesses this property, on account of its volatility and diffusion. (Ed. Med. and S. J. li. 49.) One case is reported, however, which renders this opinion probable; and another has been

communicated to me, which tends to bear out this view of its operation. The question is yet unsettled; but as Dr. Geoghegan has observed, it is a matter of considerable importance in respect to the medicinal use of the acid. Serious effects have repeatedly resulted from slight alterations made in the dose; but the proper test would be to observe, whether such effects follow, when the same dose of the poison is long continued.

POST-MORTEM APPEARANCES.—The body commonly exhales the odour of prussic acid when seen soon after death; but if it has remained exposed for some time before it is seen, and more especially if exposed to the open air or in a shower of rain, the odour may not be perceptible. In cases of suicide or accident, the vessel out of which the poison has been taken, will commonly be found near; but there is nothing to preclude the possibility of a person throwing it from him in the last act of life. Putrefaction is said to be accelerated in these cases; but from what I have been enabled to collect, there seems to be no ground for this opinion, any more than in the case of poisoning by opium. (See case by Mr. Nunneley, Prov. Med. Jour. July 30, 1845.) Orfila has shown that in most instances of sudden death from whatever cause, putrefaction is, cæteris paribus, accelerated; and the fact that in one or two instances, the bodies have speedily putrefied, has improperly led to this condition being set down as one of the characters of poisoning by prussic acid. The morbid appearances are very slight. The body externally is commonly livid, the nails have been found blue and the fingers clenched; the jaws firmly closed with foam about the mouth, the face bloated and swollen, and the eyes have been observed to be glassy, very prominent and glistening, but this condition of the eyes exists in other kinds of death. The venous system is gorged with dark coloured blood:—the stomach and alimentary canal are in their natural state; but in some instances they have been found inflamed. The mucous membrane of the stomach of a dog which died in a few minutes from a dose of three drachms of Scheele's acid—was intensely reddened throughout, presenting the appearance found in cases of arsenical poisoning. The same redness was observed in the cases of the Parisian epileptics. (Ann. D'Hyg. 1829, i. 507, G. H. R. April, 1845.) On opening the stomach, the odour of prussic acid is commonly perceptible for several days after death:—if death has been rapid, the dose large, and the inspection recent, all the cavities as well as the blood may have the odour. Besides these appearances the brain and lungs have been found congested although not invariably, the blood in some instances quite liquid, in others thick and semi-coagulated (Heller's Archiv. i. ii. 1845, p. 143.) In some instances this liquid has been found of a very dark colour, in others, red (Heller's case suprà) and in other cases again of a pinkish hue. Heller found that in one case the blood contained no fibrin on a chemical and microscopical examination (suprà.) In two instances, reported by Mertzdorff, the contents of the gall-bladder had a blue tint, but in the generality of cases there has not been observed any abnormal

change in this liquid. The larynx, trachea, and œsophagus are said to have been found reddened; but it is not impossible, that this redness may have depended on accidental causes. Death commonly takes place with such rapidity, as scarcely to allow of the production of any well-marked morbid changes in the living body. In a case reported by Dr. Geoghegan, where a man swallowed an ounce of prussic acid, and was found dead, the only morbid appearance of note discovered, was a patch of dark red extravasation, under the mucous membrane of the stomach near the pylorus. The stomach in this case, exhaled the odour of hydrocyanic acid, although it had been exposed for three days, but the poison was easily detected by the usual means in its contents. In Mr. Pooley's case the dark colour of the blood, appears to have been the only striking appearance: (Med. Gaz. xxxv. 859 :) in this case the lungs were not congested, in Mr. Hicks's case they were much congested, while in Mr. Nunneley's case they were only partially congested! (Prov. Med. Journal, July 30, 1845.) From this account, it will be perceived, that there is but little to be derived from an inspection of the body, at all characteristic of the mode of death; and probably in many cases no suspicion of the cause would be excited, except for the occasional presence of the well-known odour. In a case reported by Mr. Crisp, (Lancet, Sept. 14, 1844,) the abdominal and thoracic viscera were healthy with the exception that they had a purple colour from the blood: he could perceive no odour. In cases of poisoning by prussic acid pathologists are in general as much at a loss, as in fatal cases of tetanus and hydrophobia.

Taste and odour of prussic acid.—It may be proper here to make a few remarks upon the evidence derivable from the taste and odour of this poison. The *taste* is described by Dr. Christison as pungent, some state that it is hot, others that it is bitter. (Pereira.) When the common acid is taken mixed with organic liquids, the taste is not likely to be very perceptible unless the dose be exceedingly large. In *Belany's* case the deceased swallowed the acid unmixed and she cried out that she had swallowed a "hot liquid." We may probably trust to this statement as giving us the best idea of the taste of an unmixed and fatal dose of the poison. With a certain pungency there may be likewise a sense of bitterness as in the bitter almond;—but it is obviously impossible to determine the exact kind of sensation produced on the tongue and fauces by a large dose of this poison. In an interesting case reported by Dr. Banks a girl swallowed thirty drops—she called out for "bread" and on recovery in a few hours, she had no recollection of any thing that had transpired. A small but fatal dose of the diluted acid administered in a liquid like porter or in medicine would probably have no taste.

With regard to the *odour*. Dr. Christison states that the diffused odour has a distant resemblance to that of bitter almonds: but it is accompanied with a peculiar impression of acridity on the nostrils and back of the throat. (752.) Orfila also says that it is similar to that of bitter

almonds:—this is indeed the common impression. There is undoubtedly a difference between these odours; but the difference is not perceptible to the senses of all, and the only practical point requiring notice is that the *diluted* odour of bitter almonds, would probably be pronounced by many to indicate the presence of prussic acid, especially if there existed any suspicion of violent death. Even experienced medical men have to my knowledge been deceived on this point. There are some who are unable to perceive the odour of prussic acid, even where it exists in large proportion, whether mixed with water or other liquids; while others again are peculiarly susceptible of it. With some, it does not affect the olfactory nerves at all; but produces merely a sense of constriction in the fauces. These facts appear to me to explain sufficiently why on a post-mortem examination, some persons may perceive the odour while others may not. Where many have had to form a judgment on this subject, it is much more common to find disagreement than unanimity. In the cases of the Parisian epileptics—three eminent physicians perceived no odour in the body twenty-four hours after death:—two others equally eminent, profess to have perceived an odour of *bitter almonds* eight days after death! (Orfila ii. 287.) In the case of Sarah Hart, (*Reg. v. Tawell*, Bucks Lent. Ass. 1845) two medical witnesses perceived an odour on cutting into the integuments, a third could not: while not one of the four witnesses could detect any odour of the poison in the contents of the stomach or in the blood! In Mr. Nunneley's case in less than *six* hours after death, two could perceive an odour about the nostrils of the deceased, and two could not! (Prov. Med. Jour. July 23, 1845.)

On one point, however, there ought to be no difference of opinion. We should not rely upon the presence of a mere odour of "bitter almonds" as evidence of the presence of prussic acid; but either reject this altogether or corroborate it by the application of tests to the poison in a separate state. In one instance (*Reg. v. Donellan*) the odour of bitter almonds was the only test; but there were peculiar circumstances in that case, which made up for the want of chemical evidence. It is important to observe that there are some substances, containing no prussic acid, which may give out an odour similar to that of bitter almonds. The compound called nitro-benzine possesses this odour. Dr. Skae perceived an odour of prussic acid on adding muriatic acid to meconate of lime, but he could obtain none of the poison by distillation. (North Jour. Med. May 1845, 405.) Dr. Christison quotes two instances in which there was a strong smell of bitter almonds in the fæces, although no medicine containing hydrocyanic acid had been given to the deceased. (775.) I have perceived it in the brain of a person who had died from ordinary disease, and whose body was examined soon after death. It is worthy of observation that the odour in these cases of artificial production, appears to be that of *bitter almonds*, and probably Dr. Skae refers to this odour in his experiment. I have expressly examined the contents of healthy stomachs in various states of decomposition for prussic acid both by the odour and tests, but have never found it present as a result of decomposition. I should therefore decline

assenting to the doctrine that prussic acid is thus generated from the decomposition of animal and vegetable matter, until a well-marked case of the kind had occurred to a competent observer, and the acid had been clearly separated by distillation or otherwise, and its nature established by tests. It is said to have been found by Dr. Witling on one occasion, as a spontaneous product of the decay of unsound cheese. (Christison 756.) But in distilling with water 230 grains of decayed cheese at a gentle heat, I could not detect the slightest trace of prussic acid. The liquid product contained only the volatile matter of the cheese and sesquicarbonate of ammonia. Dr. Witling's observation therefore requires to be corroborated. It is not likely that so volatile a poison should be formed under such circumstances without being dissipated as rapidly as it is produced. (See Med. Gaz. xxxvi. p. 328.)

The circumstances which may lead to a loss of the odour in a dead body are long exposure to a free current of air—the smallness of the dose taken—absorption and elimination of the poison where the individual survives some time—the degree of dilution of the poison with water or other liquids, and lastly, its concealment by other odorous bodies such as vinous liquids, peppermint, or bitter almonds. (G. H. Reports, April, 1845.) Dr. Lonsdale found in his experiments on animals that the smell might be perceived for eight or nine days after death, although he could not detect the acid chemically for more than four days. (Ed. Med. and S. J. li. p. 52.) In the case of *Ramus* (Ann. D'Hyg. 1833, 365) the odour was detected in the liquid distilled from the stomach *seven* days after death, but not before distillation, and it yielded traces of prussic acid. This fact of the detection of the odour *after* but not *before* distillation, well-known to all medical jurists, was absurdly made a point of great difficulty at the trial of Tawell for the murder of Sarah Hart, although the simple explanation is that the poison is thereby separated more or less from other odorous substances which tend to conceal it.

In one instance where three drachms had probably been taken I found no odour in the stomach or its contents after twelve days. (G. H. Reports, April, 1845.) In Mr. Hicks's case, examined ninety hours after death, where not more than nine-tenths of a grain had been swallowed and the individual died in twenty minutes, the contents of the stomach smelt strongly of prussic acid. It was also perceived on opening the cavity of the chest: but there was no odour of the poison about the mouth or in the room, although Mr. Hicks was present ten minutes before death. (Med. Gaz. xxxv. 893.) In Mr. Pooley's case, examined twenty-two hours after death, the smell was perceived in the stomach but no where else. (ib. p. 859.) In an interesting case communicated to the Lancet (Sept. 14, 1844,) by Mr. E. Crisp of Walworth, in which a very large dose had probably been taken, he could detect no odour of prussic acid *in any part of the body*, although the inspection was made *seventy* hours after death: but a friend who was present thought he could perceive it. In a case in which a man swallowed nine-tenths of a grain and began to recover only after four hours,—the matters then for the first time thrown off the stomach, had no smell of prussic acid. (Med. Gaz. xxxvi. 104.) Neither the dose nor the circumstances under which the body is exposed, will always suffice to explain these anomalies.

In the stomach of a dog poisoned by Mr. Hicks, three drachms of Scheele's acid having been introduced by the stomach pump, the odour was perceptible to some persons,—(but not to others) twenty-four hours after death, although the stomach had been laid quite open, freed of its contents, soaked in cold water and placed for some time under a current of water. Mr. Hicks and I subsequently detected prussic acid in it by tests both with and without distillation. (Med. Gaz xxxvi. 328.) This shows how completely organic matter becomes occasionally impregnated with the acid, but it is of course continually passing off—a fact proved by testing it in a way to be hereafter described.

Some objection was taken at the trial of *Tawell* to a very short abstract of a case by Mertzdorff, reported in the first edition of this work, because it tended to bear out what is beyond all question an established and undeniable truth, i. e. the occasional disappearance of the odour of prussic acid in the dead body. No odour was perceived in or about the body of a youth poisoned by three and a half drachms of an acid, five times the strength of that of the London Pharmacopœia, but it is said to have been perceived in the contents of the stomach. It is of itself sufficiently remarkable that with such a large dose the body and the cavities should have had no odour; but in order to meet any future objections of so purely technical a character, I have here brought together a series of cases which I think, will satisfy the reader, of the truth of the principle for which alone Merzdorff's case was originally brought forward, namely, the *uncertainty* of the evidence from the odour; and to these may now be added that of Sarah Hart, showing that to some persons very shortly after death, the odour may be perceptible, while to others it will be altogether absent. The counsel for the prisoner *Tawell* stated his firm conviction that the woman had died from some one of the numerous causes of sudden death and not from poison! Tawell confessed that he poisoned her, and thus put an end to a very ingenious theory, founded on principles, which every well-informed medical jurist must know to be utterly false and erroneous.

QUANTITY REQUIRED TO DESTROY LIFE.—This is a very important question: and it is made somewhat perplexing by the fact, that beyond a certain dose, the weak and the strong acid appear to act with equal rapidity. (Christison, 658.) It has been already stated, (anté, p. 61,) that six drops have been found to destroy the life of an animal —as rapidly as one ounce of the same acid :—the animals being alike in strength and vigour. (See also Pereira, Mat. Med. i. 439.) If any inference could be drawn from these experiments applicable to the human subject, it is clear that the view often adopted, of the rapidity of death being in proportion to the largeness of the dose, is erroneous. This view may be true to a limited extent; but it appears to me that a most improper application of the doctrine has been made from a few experiments. Admitting that two drachms of Scheele's acid, will certainly kill an adult within a given period, it by no means follows that four times that quantity would kill a similarly constituted person, within one-fourth of that period. Yet this has been made the basis of evidence by medical witnesses, as if it were a positively established fact. I have sought through works on toxicology and our periodical journals, in vain for cases by which such a view could be supported. It is directly opposed to what we observe in the action of other poisons; for it is in general impossible to say, within what time a case will prove fatal, from the actual quantity of poison taken. In one instance related by Dr. Geoghegan, a quantity of the acid, equal to twenty-seven drops of the English pharmacopœial strength, (at two per cent.) was taken by a gentleman without any effect, the dose having been gradually raised to this point; but no bad consequences whatever had resulted from the acid previously taken. He now raised the dose to thirty-six drops, and in two minutes he was seized with the usual symptoms, and nearly lost his life. (Dublin Med. Journ. viii. 308.) The quantity of anhydrous acid, (0·66 grain) swallowed in this dose, was less than three quarters of a grain, i. e.

about equal to eighteen drops of Scheele at four per cent. Cases hitherto observed, show that there is a very narrow line, between the quantity of the poison which may be taken with impunity, and that which is required to produce death. In determining the quantity necessary to prove fatal, we must, it appears to me, avoid the results obtained by experiments on animals, and look to those facts only, which have been ascertained from observation on the human subject. In general, the quantity taken is extremely large; but the *smallest* dose which is reported to have caused death, was in the case of Mr. Hicks's patient. (Med. Gaz. xxxv. 896.) The female, a healthy adult, died in twenty minutes from a dose equivalent to *nine-tenths* of a grain of anhydrous Prussic acid. This was equivalent to forty-nine drops of the London Pharmacopœial acid, and taking Scheele at four per cent, (Pereira,) to about twenty-five drops of Scheele. In an interesting case reported by Mr. T. Taylor, (Med. Gaz. xxxvi. 104,) a stout healthy man swallowed this dose, nine-tenths of a grain, by mistake, and remained insensible for *four hours*, when he vomited and began to recover. The vomited matters had *no odour* of the poison, showing that if not concealed by other odours, the whole of the acid must have been here absorbed. He had a very narrow escape of his life. Dr. Banks has published a case in which a female recovered after swallowing thirty drops of prussic acid, (Ed. Med. and Sur. Jour. xlviii. p. 44,) but the interest of this case is lost, owing to the strength of the acid not having been determined. It is advisable to put no trust in any statements bearing upon an important question of this kind, where a direct analysis of part of the poison swallowed, has not been performed. Serious mistakes may be made by deciding on the strength of a fatal dose, by the *average* strength of the variety of acid that has been taken;—since what is called Scheele's acid may thus vary from two to five per cent.: and in the reports of cases it would be advisable, that the dose taken, should always be expressed in the quantity of *anhydrous*, and not of the diluted acid.

By trusting to this kind of calculation all English medico-legal writers have been misled with respect to the dose taken by the seven Parisian epileptics. Dr. Christison, Dr. Lonsdale, and Dr. Geoghegan had stated the dose which here proved fatal, at about two-thirds of a grain. A similar dose was assigned to these cases in the former edition of this work, and the mode in which the mistake arose is sufficiently explained by Dr. Lonsdale. (Ed. Med. and Sur. Jour. loc cit.) Some reflections have been made upon English writers in relation to this error; but it has been overlooked or concealed,—that Orfila himself who was made the standard of accuracy on these occasions, gives *two different versions* of the dose;—Devergie gives another account, and Guibourt a fourth! (See Med. Gaz. xxxv. 896; also Pharmaceutical Journal, May, 1845, 515,) and the only inference which a medical jurist can draw from all this confusion, is, that it is now utterly impossible to assign the real dose taken; because no direct analysis appears to have been made of any portion of the hydrocyanic syrup actually *swallowed*;

and it appears to me that to any evidence short of this, we cannot trust in legal medicine.

The *largest* dose from which an adult has recovered was probably in a case reported by Mr. Nunneley of Leeds. (Prov. Med. Jour., Aug. 13, 1845, p. 517.) The person swallowed, it was supposed, *forty minims* of an acid at three and a quarter per cent. Taking the minim as equal to the grain, although it may be a little more or less according to circumstances, (see infrà,) this is equivalent to about *one grain and one-third* of anhydrous acid. The man was for a short time conscious, got into bed after taking it, and spoke. He felt his jaw become stiff and then remained insensible, until roused by the cold affusion. The fact of recovery having taken place here, must not lead us to suppose that such a large dose could be commonly taken with impunity. If we refer to the chapters on arsenic and corrosive sublimate, we shall find that persons have recovered from doses of these poisons, much larger than those which have proved fatal in other cases. The same circumstance is observed in respect to all other poisons. Judging by the effects produced in Dr. Geoghegan's case from 0·66 grain of anhydrous acid,—from the fact that death took place in Mr. Hicks's case from nine-tenths of a grain, and that in another instance, a strong adult had a narrow escape of his life from the same dose, I see no reason to alter the opinion expressed in the first edition of this work, respecting the probable fatal dose of this poison, namely, that a quantity of Scheele's acid (at five per cent) *above twenty drops*, (i. e. *one grain of anhydrous acid,*) or an equivalent portion of any other acid, would commonly suffice to destroy life. Even less than this—seven-tenths of a grain might under favourable circumstances prove fatal. We have no certain evidence from recorded facts, that three grains of arsenic have yet destroyed the life of an adult; but the probability is, that that quantity would be a fatal dose. Neither seven-tenths of a grain of Prussic acid nor three grains of arsenic might suffice to kill *every* person; but this is not the kind of information which the law requires. A witness is only required to say what dose will under ordinary circumstances, commonly suffice to destroy life.

In estimating doses, it may be proper to state the results of some experiments on the weight of given measures of this poison. Sixty drops of the P. L. acid, or one drachm measured in a drop measure, commonly used in a laboratory, weighed 64 grains; sixty minims in a measure used in the dispensing department of Guy's Hospital, weighed 61 grains; and the same quantity in a measure procured from a large retail druggist's, weighed 62·5 grains. One drachm in a common two ounce measure, weighed 63 grains, and one ounce in the same measure balanced, weighed 444 grains, which gives an average weight of 55·5 grains for each drachm. To ensure accuracy these experiments were performed by double weighing; and the results show how little certainty there is, with respect to the exact quantity of the anhydrous acid in minim and drop doses. The stronger the acid, the less the weight of a given bulk, since the specific quantity

diminishes in proportion as the water becomes saturated with the anhydrous acid. An ounce of distilled water should weigh at 62° 437·5 grains,—a drachm should weigh 54·7 grains, and a minim or drop 0·91, or 91-100ths of a grain.

The *medicinal dose* is from a minim to two minims of Scheele's acid, and from three to five minims of the London Pharmacopœial acid gradually increased. In giving an opinion on the quantity required to destroy life, it is material to know the variety of acid taken; and here it is much to be regretted, that in the British empire, no uniform standard is adopted for so powerful a medicine. The following may be taken as the per-centage strength in anhydrous acid of the different varieties of this acid, British and foreign, in *aqueous* solution, on the authority of Dr. Christison and Dr. Pereira. Acid of Schrader, 1 :—Dublin Pharmacopœia, 1·6 :—London Pharmacopœia. 2 :—Göbel, 2·5 :—Edinburgh Pharmacopœia, 3·2 :—Vauquelin and Giese, 3·3 :—Scheele, 4 :—Ittner, 10 :—Robiquet, 50 :—Among the *alcoholic* solutions of the acid,—Schrader, 1·5 :—Bavarian Pharmacopœia, 4 :—Duflos, 9 :—Pfaff, 10 : —Keller, 25 per cent.

Period at which death takes place.—Some remarks have already been made on this subject, and it has been particularly stated that beyond a certain point, we are not entitled to infer, that the rapidity of death bears any proportion to the quantity of poison taken. Experiments on animals might be adduced to prove either the negative or affirmative of this proposition, a fact which clearly shows, that they cannot be admitted in this particular, as a basis for medical evidence. In the seven Parisian cases, where a similar dose was given to all, death took place at very different periods,—the first person died in about fifteen or twenty minutes, and the last only after three quarters of an hour! In one instance in which seven drachms were taken, death took place within five minutes:—in another, in which an ounce was taken, the individual survived about ten minutes. (Sobernheim.) When the dose is two drachms and upwards, we may probably take the average period for death at from two to ten minutes. In Mr. Hicks's case forty-nine drops of P. L. acid destroyed life in twenty minutes. It is only where the dose is just in a fatal proportion, that we find the individual to survive from half an hour to an hour. In this respect, death by prussic acid is like death by lightning :—the person either dies speedily or recovers altogether.

But although death does not commonly ensue until after the lapse of a few minutes, insensibility, and consequently a want of power to perform acts of volition and locomotion, may come on in a few seconds. The time at which this loss of power is supposed to take place, has already become an important medico-legal question; and on the answer to it, the hypothesis of suicide or murder in a particular case, must rest. Dr. Lonsdale says on this point, that a drachm of Scheele's acid would affect an ordinary adult within the minute; and if the dose were three or four drachms, it would exert its influence within ten or fifteen seconds. When the acid is stronger and the quantity larger,

we are pretty certain of its *immediate* action, and the consequent annihilation of the sensorial functions. (Ed. Med. and Surg. Journ. li. 50.) This opinion is, however, founded entirely on experiments on animals. Christison ascertained that a quantity of poison, equivalent to two scruples of medicinal acid, did not begin to act on a rabbit for twenty seconds, and certainly for so small an animal, two scruples are as large a dose as *five drachms* given to a grown-up girl. These statements appear to me to show clearly that experiments on animals cannot enable us to solve this question: we should rather trust to the few observations made on the human subject, as well as to analogy from other sources,—as, for example, to the fact of survivorship after the receipt of what are commonly regarded as instantaneously mortal wounds.

A case was communicated to me, some time since, by one of my pupils, where a man was found dead on the seat of a water-closet: he had died from prussic acid, and the bottle which had contained the poison, was found in his pocket, corked. Many similar facts are recorded which show, that while, as a general rule, insensibility may supervene from a large dose of this poison in a few seconds, the individual occasionally retains a power of performing certain acts, indicative of consciousness, volition and locomotion. In Mr. Nunneley's case the man was enabled to speak rationally, and answer a question after he had swallowed a fatal dose. (Prov. Med. Journ., July 23, 1845.) These facts are important in relation to a case which was tried at the Leicester Spring Assizes in 1829. *Rex v. Freeman.*

A young man, named Freeman, was charged with the murder of a female, named Buswell, by administering to her prussic acid. A full report of this case will be found in the Medical Gazette (vol. viii. p. 759). The deceased was a maid-servant in the family of a chemist, to whom the prisoner acted as assistant. The deceased was one morning found dead in her bed: her death was evidently caused by prussic acid, and it was presumed that she had taken four-and-a-half drachms of the poison; the bottle out of which she must have drunk it, or had it administered to her, holding an ounce, and still containing, when found, three-and-a-half drachms. Owing to the position, and other circumstances connected with the body when discovered, it was inferred that she could not have taken the poison herself. Her body was lying at length on the bed, the head being a little on one side. The bed-clothes were pulled up straight and smooth, and they came up to the breast of the deceased;—her arms were under the clothes, and crossed over the chest. On turning the clothes aside, the phial which contained the poison was found lying on her right side. It was corked, and there was a piece of white paper round it,—the leather and string which appeared to have gone round the neck of the bottle, were found in the chamber vessel. The medical question was,—Could this quantity of poison have been taken, and the deceased have afterwards performed these acts herself? Five medical witnesses were examined, and the opinions of four of these were strongly against the possibility of the acts having been performed by the deceased. One of the witnesses ascertained, that a dog to which the same quantity of acid was given, as was taken by the deceased, died in about three seconds. The medical opinion was founded on experiments of this kind; for there were no cases from the human subject, by which it could be supported. All of the acts to which the opinion referred, might be performed in from five to eight seconds; and there is nothing to warrant us in supposing, that under the above named dose, all power would necessarily have ceased before that period of time had elapsed. Dr.

Christison's experiment on the rabbit would lead to the inference that even five drachms would not begin to act upon a grown-up girl for twenty seconds; (668), and the results obtained by the witnesses from their experiments on dogs, were by no means uniform, even allowing that they were justified in applying them to the settlement of so important a question as this. The medical opinion was completely set aside by circumstances, and the prisoner was acquitted.

A similar case has since occurred in Germany, and is quoted by Sobernheim. A young man swallowed four ounces of an acid (of four per cent.) equivalent to eight ounces of the pharmacopœial strength. He was found dead in bed,—the clothes drawn up to his breast, the right arm stretched out straight beneath the clothes, the left bent at the elbow-joint, and on each side of the bed lay an empty two-ounce phial. There was no doubt of this having been an act of suicide. In this case more than three times as much acid was taken as in that of Buswell, but even here there was time for the performance of very similar acts. It is besides much more difficult to understand, how the poison should have been taken out of two phials, than out of one.

Since the publication of the first edition of this work I have had to examine a case of suicide by prussic acid, in which the facts were strongly confirmatory of the views here expressed. The deceased swallowed three drachms of prussic acid and was found dead in bed, the clothes being smoothly drawn up to his shoulders, and there was no appearance of disorder about them, nor was there any sign of struggling before death. On a chair at the back of the bed but close to it, was the phial which contained the prussic acid with the cork in it. (G. H. Reports, April, 1845.) In Mr. Crisp's case, the bottle with the stopper was found in the chamber-vessel, which had been pushed some distance under the right side of the bed, and here a very large dose had most probably been taken. (Lancet, September, 1844.) It has been supposed that under these circumstances of survivorship, the body should always be found convulsed, but this opinion is not borne out by facts. Here are cases of undoubted suicide, in which the body is found lying calm and tranquil without any mark of struggling or convulsions,—whether convulsious had taken place or not, is quite immaterial, there was nothing to indicate that such symptoms had followed the ingestion of the acid. A very interesting case has been lately published by Mr. Leithead of Warkworth. A girl destroyed herself by prussic acid and the evidence proved so far as the facts could be proved, that she had swallowed an ounce of the acid, recorked the phial, thrust the bottle to a full arm's length between the feather-bed and the mattress,—got into bed, and then drawn the clothes over her body; there appeared to have been no convulsions. One medical man fancied he perceived the odour of prussic acid about the mouth, but another could not perceive it. (Lancet, June 7, 1845, 640.) This case appears to decide the question i. e. that under a large dose without convulsions,—insensibility or loss of consciousness may not come on until after the lapse of a sufficient time for the individual to perform acts which a few years ago, from experiments on animals, were deemed impossible. Locomotion and muscular exertion are, of course, compatible with small but fatal doses of the poison. In Mr. Hicks's case, the girl sprang up from her seat after swallowing the fatal dose, threw her arms over her head, gasped for breath, and ran forwards about two yards before she fell. In Mr. T. Taylor's case, the man ran twelve or fourteen paces before he fell, and remained insensible for a space of four hours,—a very long duration for the effects of the poison without causing death. Other cases recently observed, have shown that prussic acid does not give rise to insensibility and other alarming symptoms so speedily, as it was formerly supposed. Mr. Garson of Stromness has reported a case in which a person for medicinal purposes, took at least a teaspoonful of prussic acid (the strength not mentioned); the symptoms, however, did not come on for a *quarter of an hour*, when the patient was found insensible. He recovered and stated that that period of time had probably elapsed between the taking of

the dose and the commencement of the symptoms, and that he had employed himself in writing during the intermediate period! (Ed. Med. and Surg. Journ. lix. p. 72.) Perhaps one of the most extraordinary cases on record in this respect is that related by Mr. Godfrey. A gentleman swallowed, it was supposed, half an ounce of prussic acid, (strength not stated,) but certainly a quantity sufficient to destroy life. After taking it from the bottle, he walked ten paces to the top of a flight of stairs, descended the stairs seventeen in number, and then went to a druggist's shop, where he had previously bought the poison, at forty-five paces distance, entered the shop, and said in his usual tone of voice, "I want some more of that prussic acid!" He then became insensible and died in from three to ten minutes after taking the poison. This case is further of interest from the fact, that although it was an instance of *slow death*, there were *no convulsions*, there was no odour of prussic acid about the mouth, and the individual died in the presence of several medical men, without any shriek or any symptom approaching to it, being observed! (Prov. Med. Journal, Sept. 25, 1844.) Facts somewhat similar were witnessed by Mr. Nunneley, in a case reported in the same journal. (July 23, 1845.)

Can a man, after having taken prussic acid, live sufficiently long to attempt or perpetrate suicide in any other way? The following case occurred in London in April, 1839. A solicitor's clerk was found hanging quite dead at his chambers. He had evidently taken prussic acid; for a cup was lying near him which had contained that poison. The medical witness here very properly inferred, that the man did not swallow the poison until after he had adjusted the rope round his neck. It could hardly be admitted that a man should have power to hang himself, after having taken a large dose of this poison, but a person might be found drowned with prussic acid in his stomach, and without this fact being incompatible with suicide. It is however a matter of doubt, determinable only by special circumstances, whether a man could or could not destroy himself by fire-arms after having swallowed the poison. This question often presents itself in another form, namely, whether the act of poisoning was the result of *accident or suicide*,—a most important question, where the life of the deceased happens to be insured. In general the circumstances are such as at once to explain the nature of the act; but a medical witness must remember that there is no case in which suicide may be so secretly perpetrated by poison, as by means of prussic acid. There are besides many ways in which the means of death might be concealed; and as it is so little the custom to cause an inspection to be made of the bodies of those who have died suddenly, unless a suspicion already exists of death having been caused by poison, such cases might easily escape detection. (See Borough Inquests, 1845, by Dr. Birt Davies.) In the event of litigation ensuing, in respect to a policy of insurance it may be too late to discover any traces of poison in the body. It is proper therefore to remark, that the effects of prussic acid may be easily confounded with all diseases which are liable to destroy life suddenly, such as epilepsy, apoplexy, and diseases of the heart.

The case of *Mrs. Maclean*, who was found dead in her house at Cape Coast Castle, in October, 1838, is interesting to the medical jurist, in relation to the question of suicide or accident. Her attendant, in going to the room of

the deceased, found some difficulty in opening the door, in consequence, as it appeared, of the body of the deceased having fallen against it. The deceased was lying on the floor, quite senseless, with an empty bottle in her hand, uncorked, and labelled "hydrocyanic acid, medium dose five minims." There was a feeble pulsation of the heart, which soon ceased. It appeared that the deceased was in the habit of taking prussic acid as a medicine; and the medical witness supposed, that she might have taken an overdose, and have thus been killed accidentally; he was so fully convinced that the medicine was the cause of death, that he did not open the body. By this omission, the case was left in mystery; for had the body been inspected, and the larger portion of the contents of the bottle been found in the stomach, there would have been no doubt of its having been an act of suicide; since a well-informed person like the deceased, was not likely to have swallowed by accident a large dose of a poison, with the deadly properties of which she must have been perfectly acquainted. If the acid were taken medicinally, and an overdose swallowed by accident, it is singular that the bottle should have been found in her hand; since we cannot suppose that any well-informed person would take a medicinal dose of prussic acid conjecturally, by swallowing it from the bottle itself. In consequence of this omission to inspect the body, it is now difficult to say whether this was an act of suicide or the result of accident.

Treatment.—Experience justifies us in employing stimulants, such as diluted ammonia, to the nostrils, and frictions of the compound camphor liniment to the chest. Chlorine has been strongly recommended to be injected in the state of solution into the stomach; but admitting that it were at hand to be administered in a case of poisoning which seldom lasts above a few minutes, it is a remedy of very doubtful character. Lately Messrs. Smith of Edinburgh have proposed the mixed oxides of iron as an antidote,—these forming on contact with prussic acid, insoluble Prussian blue. Ittner and Chancel long since recommended a mixture of sulphate of iron and potash. (Lonsdale.) The jaws are, however, commonly so firmly closed, that it is difficult to make the individual swallow anything, and the poison operates with fatal rapidity. It has been proposed to apply electricity in the course of the spinal marrow; but the best remedy, and that which is always applicable, is cold affusion. In experiments on animals, this has been found an efficacious mode of treatment, and in several cases in the human subject, one of which is reported by Dr. Banks of Louth. A girl took by mistake in medicine, thirty drops of prussic acid. Immediately afterwards, she sprang up convulsively from her seat, and became senseless. Her teeth were firmly set, and her eyes staring and fixed. Stimulants failed to rouse her:—the limbs became flaccid;—the pupils dilated, and she was wholly insensible;—the respiration was slow, and the pulse scarcely perceptible. A stream of cold water from a pitcher was allowed to fall from some height on the region of the spine. In a minute she began to move, and became convulsed; her symptoms abated, and in a few hours she was quite collected. She recovered in a few days, but there is hardly a doubt that she would have died, had she not been thus treated. (Ed. Med. and Sur. Jour., xlviii. 44.) In Mr. T. Taylor's case, (antè p. 245,) the man in falling, broke a large vessel of water which saturated his dress and probably aided his recovery. He was restored by ammonia and cold affusion.

In Mr. Garson's case, (Ed. Med. and Sur. Jour., lix. 72,) cold affusion and the use of ammonia, appear to have been attended with the best effects. Bleeding from the jugular vein is strongly recommended by Dr. Lonsdale. It is likely to be beneficial when there is any sign of cerebral congestion.

CHEMICAL ANALYSIS.—Prussic acid is limpid like water; it possesses a faint acid reaction and a peculiar odour, (antè, p. 241,) which, when the acid is concentrated, although not at first perceptible, is sufficient to produce giddiness and insensibility. The odour has been present in cases in which it has been found quite impossible to separate the acid by distillation, or up to the present time, to determine its nature by chemical tests. (See Orfila, Annales d'Hygiéne, 1829, and Dr. Lonsdale's experiments, Ed. Med. and Surg. Jour. li. 52.) Dr. Christison states "that the smell has been perceptible in the blood, when analysis cannot succeed in separating it," 760, 774. From this it would appear to be more delicate than the chemical tests, and so I was inclined to regard it in the first edition of this work: but I have recently been able to detect the acid easily in organic mixtures, in which the odour was not apparent to several persons or to myself. (See Med. Gaz. xxxvi. 328, and Mr. Hicks' experiments, ib. 588 and 631.) The chemical tests for prussic acid are two. 1. *Nitrate of silver.*—This yields, with prussic acid, a dense white precipitate, speedily subsiding in heavy clots to the bottom of the vessel, and leaving the liquid almost clear. The precipitate is identified as cyanide of silver by the following properties:—*a*, it is insoluble in cold nitric acid, but when drained of water and a sufficient quantity of strong acid added, it is easily dissolved on boiling. It has been asserted that it is soluble in *cold* nitric acid, but this only applies to those cases where the quantity of precipitate is very small and the proportion of nitric acid very large. Under ordinary circumstances, cold nitric acid dissolves scarcely any perceptible portion, and thus easily distinguishes the cyanide from the oxalate, carbonate and some other salts of silver:—it is important to observe that it is slightly soluble in a large excess of nitrate of silver: *b*. it is soluble in a large excess of solution of potash (care being taken that some free hydrocyanic acid is present) it is also soluble in ammonia, but this is by no means a distinctive character, and therefore is unimportant: *c*. it evolves prussic acid when digested in muriatic acid: *d*. this precipitate, when dried and heated in a small reduction tube, yields cyanogen gas, which may be burnt at the mouth with a rose-red flame and blue halo. This is a well-marked character, and at once identifies the acid, which yielded the precipitate, as prussic acid; by this property the precipitate is eminently distinguished from the chloride, oxalate, and all the other salts of silver. I have ascertained by experiment, that in a small tube, three-fourths of a grain of the precipitate, which is equal to about eight drops of the common acid, will furnish good evidence; and that one-tenth of a grain is the limit for this decomposition; but by this quantity we can determine the presence of less than the 50th part of a grain of anhydrous acid! 2. *The Prussian blue test.* For this purpose we add to the liquid a few drops of potash and of solution of green sulphate of iron. A dirty green or brownish coloured precipitate falls; on shaking this for a few minutes, and then adding diluted muriatic or sulphuric acid, the liquid becomes blue; and Prussian blue, of its well-known colour, unaffected by diluted acids, subsides. If the prussic acid be in very small quantity, the liquid is green, but the precipitate always subsides of a blue colour. The same result is obtained, by adding the solution of the iron-salt to the potash solution of the cyanide of silver; and thus in this way, the two tests may be applied to only one portion of the poison. (See G. H. Reports, April, 1845.)

Objections.—Some remarks have been already made on the evidence derivable from the odour (p. 243)—it cannot be relied on, unless other facts be forthcoming; although in one case, where moral circumstances were strong, (case of *Sir T. Boughton,*) a Court of law accepted it as the only evidence of the presence of the poison. With respect to the silver test, numerous acids are pre-

cipitated white by it, but the precipitate obtained from prussic acid only, possesses the properties above described; and unless these properties are demonstrated, no evidence from the application of this test, should be admitted as satisfactory. The production of Prussian blue from the green sulphate of iron, is peculiar to prussic acid, and is free from all objection. I have found this test to act in cases where the nitrate of silver gave no precipitate, or only a faint cloudiness. It has also this advantage over the nitrate of silver as a test, that it will act where the poison happens to be mixed with some other acid or salt precipitable by the nitrate, as with muriatic acid or common salt. It may be a question whether both of these tests are necessary, the one for the corroboration of the results obtained by the other, or whether there would not be sufficient proof of the presence of prussic acid by the application of *one* only. The use of *one* of the tests, is in my opinion sufficient, provided in the case of the precipitate obtained by nitrate of silver, we can procure the necessary evidence of its nature by the combustion of cyanogen; and provided that in the case of the iron-test, we can determine the precipitate to be Prussian blue. The colour is a strong, and, it may be considered, a sufficient proof, as no other blue compound can be possibly formed under the circumstances. For any additional chemical characters, see PRUSSIAN BLUE. The admixture of a small quantity of chloride of silver with the cyanide, does not interfere with the production and combustion of cyanogen by heat. Prussian blue may, however, be easily obtained from cyanide of silver, either by receiving the cyanogen on paper moistened with the mixed oxides of iron and a small quantity of alkali, or by conducting the gas into a similar mixture placed in a small tube-receiver. Another method will be described hereafter.

In organic mixtures. Without distillation.—The contents of the stomach under the limitations mentioned, (antè, p. 243,) have an odour of the poison. I have remarked that the presence of prussic acid tends to prevent these organic mixtures from becoming mouldy or decomposed. It is a great object, if possible, to obtain evidence of the presence of the acid before resorting to the common process of distillation, especially where the presence of an odour is doubtful. This precaution may prevent any objection being raised, to the effect that the prussic acid might have been a product of distillation. After trying many experiments, I have found the following plan which is a modification of one recommended in the last edition, to answer both with the liquid contents and the solid substance of the stomach. It will also succeed with the blood, muscles and viscera, and serve to distinguish between the actual presence of prussic acid and the mere odour of some adventitious substance resembling it in this respect. If the liquid for examination be alkaline, it should be acidulated with sulphuric acid; if acid, it may be at once placed in a wide-mouthed bottle, the aperture of which is capable of being covered by a watch-glass, or a saucer of white porcelain. The inside of the watch-glass or saucer should be moistened with nitrate of silver, and placed over the mouth of the bottle: if prussic acid be present the spots of nitrate will become of a dead white in the course of a few seconds, or in from ten minutes to a quarter of an hour, according to the quantity of poison present, and the closeness of the test to the liquid. No heat need be applied to the liquid contents,—a temperature of 64° suffices for the result, but the warmth of the hands accelerates the action; the deposit thus formed, is sometimes soluble in cold and concentrated nitric acid, (heat being evolved by mere admixture) but it is always easily dissolved on boiling. It might be objected, that muriatic acid would act on the nitrate of silver in a similar way. Having mixed one drachm of pure fuming muriatic acid with eight ounces of porter and placed a watch-glass three inches above the level of the liquid, there was scarcely any film on the nitrate after half an hour; while *two thirds of a grain* of anhydrous prussic acid, mixed with *eight ounces* of porter, placed under precisely similar circumstances, gave a well-defined deposit of cyanide of silver in a quarter of an hour. The proportion of muriatic acid was here much larger than that which exists naturally in the gastric secretions, so

that except in cases of poisoning by muriatic acid, the objection could not hold. Besides chloride of silver is insoluble in *boiling* nitric acid and changes rapidly when exposed to light; the cyanide is soluble, and is but little affected by light. It is difficult by this process to procure a sufficient quantity of cyanide of silver for the combustion of cyanogen; this led me to try the Prussian blue test, by substituting in the watch-glass, weak caustic potash for nitrate of silver; and after a few seconds or a few minutes, according to the quantity of poison present, sulphate of iron and diluted muriatic acid were added to the potash in the usual way. The result was perfectly satisfactory; for even with only two-thirds of a grain of anhydrous acid to eight ounces of porter, Prussian blue was obtained. This mode of testing, equally succeeded with the stomach of a dog, after it had been thoroughly washed in water and had been removed from the body twenty-four hours. (p. 243.)

The quantity of Prussian blue obtained by this process, is small; but the evidence is, nevertheless, conclusive; for no other acid but the prussic can produce it under the circumstances. (See antè, p. 58.) I have found that a small quantity of prussic acid in porter kept in a bottle might be thus detected after four months. The nature of the experiment proves the great volatility of this poison, and the diffusibility of its vapour. The distilled liquid of the stomach of the dog gave evidence of prussic acid one day, but it had all disappeared the day following, owing to slight exposure. I could not, however, clearly perceive the odour (although others could) in some organic liquids in which the poison has been thus easily discovered. It will be understood that unless a white film be formed on the nitrate of silver, or on the ammonio-nitrate in which the change takes place perhaps more rapidly,—the application of the Prussian blue test will fail. The silver test, therefore, serves as a guide to the analyst. Further by a little chemical manipulation it is possible to procure Prussian blue from the film of cyanide of silver by the following simple process. Add caustic potash to the film of cyanide in the watch-glass and boil,—the cyanide is dissolved and brown oxide of silver may be precipitated. Pour off the clear liquid or filter and add sulphate of iron with (after a short time) diluted sulphuric acid, Prussian blue is immediately produced. I have thus procured Prussian blue from a quantity of cyanide which was too small to yield cyanogen by heat. Under the distillatory process, the poison is necessarily diffused through a large quantity of water. I have, nevertheless, found that it was easy to detect and separate by distillation only two-thirds of a grain of anhydrous acid diffused in eight ounces of London porter. Mr. Hicks informs me that in some of his experiments the distillatory process entirely failed, and that he could only detect the poison by the method above described. Mr. West thus detected prussic acid in the blood, but could not separate any by distillation. (Prov. Med. Jour., July, 1845.) On one occasion Mr. Hicks mixed thirty drops of Scheele's acid (= 1·12 gr. anhydrous) with half a pint of porter and poured the mixture into the stomach of a recently dead subject. After *two* days he examined the contents, but neither himself nor several persons present, could detect any smell whatever of prussic acid. However, in a quarter of an hour, satisfactory evidence of its presence was procured by the absorption of its vapour in the manner described. (See Medical Gazette, vol. xxxvi. p. 632.) Mr. Hicks forwarded to me one half of the liquid and my results confirmed his. What a commentary does this experiment furnish on the sophistry allowed to be put forward in defence as received medical doctrine at *Tawell's* trial!

Nitrate of silver cannot be used as a test in an organic liquid:—but Prussian blue may be formed in a liquid of this kind before distillation, if the acid be present, by the application of the iron test. By washing the precipitate, it is deprived of organic matter, and presents its usual characteristic blue colour and other properties. Heller has thus detected prussic acid in most of the soft organs as well as in the blood, digesting them in a small quantity of potash, and then adding a salt of iron and muriatic acid. (Archiv. für physiol. Chemie, 1845, i. and ii. 143.) Experiments of this kind, if performed before distillation, will of course remove any difficulty on the score of the acid being possibly a product. (See Medical Gazette, xxxvi. 328.)

Distillation.—The second process was suggested by Lassaigne. The organic liquid may be distilled at a gentle heat in a water bath, and about one-sixth or one-eighth of the contents of the retort collected in a receiver kept cool by water. The tests may now be applied to the distilled liquid. If the trial tests indicate that the quantity of poison is small, a solution of nitrate of silver or potash may be placed in the receiver to fix the acid as it distils over; Prussian blue may then be procured in the way described. Prussic acid has been found by this process in the stomach, so late as *seven* days after death, although the odour could not be perceived before distillation (case of *Ramus*, ante, p. 243.) Orfila is said to have discovered it *eight* days after death in the cases of the Parisian epileptics, but he merely states he perceived an *odour of bitter almonds*, not that he obtained the poison by distillation! In a case where three drachms had been taken, I could neither detect it by the odour nor by the most careful distillation *twelve* days after death. (G. H. R. April, 1845.) Mr. West states that he was able to detect it on distillation by the odour and the silver and iron tests *twenty-three days* after death; although no pains had been taken to ensure its preservation, and not more than four-tenths of a grain of anhydrous acid, could have originally existed in the contents of the stomach! (Prov. Med. Jour. July 23, 1845.) It is impossible to reconcile these discordant results,—but it is easy to prove by chemical tests that the acid is always escaping from the organic liquid holding it. (See antè p. 253.) It has been alleged, that prussic acid might be generated from animal matter during the process of distillation, but this does not appear, chemically speaking, possible; and if the trial tests indicated the presence of poison before distillation, the objection would not be even plausible. If muriatic acid were present, it might distil over, and embarrass the results so far as the nitrate of silver was concerned, but it would not interfere with the other and more conclusive test, the production of Prussian blue. If an alkali is suspected to be present, as ammonia from putrefaction, it is advisable to add sulphuric acid, before commencing the distillation.

Is the discovery of prussic acid in the stomach of a person, a proof of death having been caused by it? As a general rule, we should be justified in answering this question in the affirmative. It has been suggested that the poison might be introduced or spontaneously generated after death; but if such improbable speculations as these, are to rule medical evidence, no certainty can ever be obtained. We do not here meet with the objection which applies to most other poisons, that the patient may have been cut off by disease supervening after it has been taken; since if the poison operate fatally at all, it is in the course of a few minutes. Latent diseases of the heart and brain might, it is true, by a coincidence, cut short life; the circumstances of the case may, however, be such as to remove a supposition of this kind. So where two or more poisons are found in the stomach, and one is prussic acid, there can be no reason to hesitate in assigning death to the latter. In a case which occurred in 1837-8, prussic acid and arsenic were found in the stomach after death. In another, communicated to me by Mr. Clarkson, formerly a pupil at Guy's Hospital, the mixture taken by the deceased, consisted of brandy, opium, arsenic and prussic acid. The witness must therefore be prepared for these cases of compound poisoning, and the questions arising out of them. Prussic acid, according to the quantity discovered, must not only be regarded as the cause of death, but as the poison last taken, unless there be reason to suppose that the whole of the poisons were swallowed in one mixture. It is no longer a question, whether prussic acid can be detected chemically in the blood or the soft organs of persons poisoned by it. In protracted cases, it is freely exhaled from the lungs, and the odour is often perceptible in the breath. Dr. Lonsdale states, that in animals the odour cannot be perceived in the blood or cavities of the body, when life is prolonged beyond fifteen minutes. The presence of the odour in the blood furnishes very strong evidence of poisoning. Krimer discovered prussic acid in the blood of an animal which died in thirty-six seconds; the analysis was made by distilling that liquid to dryness! The poison has since been detected in the blood by Heller and others.

Some remarks have been already made in speaking of the odour of this poison on its alleged spontaneous production in organic liquids. The process of distillation has been objected to on this account: but in my opinion without any reasonable ground. The objection appears to be merely speculative, for there is no case on record in support of it. I have frequently distilled the contents of stomachs and many organic liquids without finding any trace of the poison; and it is obvious that if this objection were sound, we should be always meeting with it in analysis. With respect to substances capable of producing it by distillation, some remarks will be made hereafter. (See Med. Gaz. xxxvi. p. 328.) I shall now only observe that a salt contained in minute traces in the saliva (sulphocyanide of potassium) is stated to be occasionally found in the stomach, and to yield prussic acid on distillation with an acid. This salt, if present, would be known by its striking a deep red colour with a persalt of iron. Having had occasion to apply this test to the contents of healthy stomachs in numerous instances for other purposes, I may state as a result, that I have never found the least trace of the sulphocyanide in the gastric secretions. Further, on distilling a strong solution of the sulphocyanide with sulphuric acid, at a gentle heat,—no prussic acid could be procured: the distilled liquid consisted simply of sulphocyanic acid sulphur and sulphuretted hydrogen. This theoretical objection was taken at *Tawell's* trial to the chemical evidence, but as the above facts show, there is not the slightest foundation for it. If it were true, a human stomach would always contain prussic acid from the reaction of the muriatic acid in the gastric secretions on the sulphocyanide contained in the saliva!

Quantitative analysis.—It is sometimes a matter of great importance, to ascertain the strength of the acid taken; and it is much more satisfactory to determine this point by chemical processes, than by giving the poison to dogs or rabbits, and noting how long a time it requires for a certain dose to destroy life. In performing this experiment, we must precipitate a weighed quantity of the acid entirely by solution of nitrate of silver, and wash and dry thoroughly, as it is very retentive of water, the white cyanide of silver, obtained. One hundred grains of cyanide of silver are equivalent to 20·14 grains of anhydrous prussic acid; this is in the proportion of about one-fifth, so that the weight of the dried cyanide, divided by five, gives with sufficient accuracy for common purposes, the quantity of anhydrous prussic acid present. One hundred grains of the London Pharmacopœial acid should therefore yield ten grains of cyanide of silver. In performing this experiment it is most important that the cyanide of silver should be thoroughly dried at 212° by placing it in a dry vessel immersed in another vessel containing water kept in a boiling state. The cyanide of silver holds water very tenaciously, and unless this be *entirely* expelled, a very erroneous opinion may be formed of the strength of the acid examined.

Oil of bitter almonds.—The bitter almond itself is a poison; it owes its poisonous properties to prussic acid, which is easily obtained from it by distillation with water. It is, however, a remarkable fact, that none of the acid exists ready formed in it, nor is the poison ever produced except by the agency of water on the almond pulp. Thus the very act of mastication produces from this pulp, the poison which destroys life. Heat is not required. I have found that prussic acid is produced on mere trituration with water. There are one or two cases on record, wherein the almonds, when eaten in large quantity, have led to fatal symptoms and death. The *Essential oil*, has given rise to a great number of accidents, and has caused toxicologists to direct their attention especially to it. Its poisonous properties are entirely due to the presence of hydrocyanic acid, which is intimately combined with it. Five pounds of the almonds are said

to yield about half an ounce of the oil, and the quantity of anhydrous hydrocyanic acid contained in it, varies from eight to fourteen per cent. (Christison.) It must, therefore, be regarded as an active poison, being at least four times as strong as the pharmacopœial acid. One specimen which I examined was, I believe, much weaker than this average strength would indicate. Its effects on the human subject will be best understood from the following cases.

A man, aged forty-eight, swallowed two drachms of the ethereal oil of bitter almonds. In a few minutes afterwards, he was found by his servant with his features spasmodically contracted, his eyes fixed, staring and turned upwards. The chest was expanded convulsively and hurriedly. In twenty minutes he was insensible, the pupils immoveable, the breathing slow and stertorous,—the breath having a strong odour of bitter almonds, and the pulse feeble. He died half an hour after he had taken the poison. On inspection, the whole of the body, and the blood which escaped, smelt strongly of bitter almonds; the teeth were fixed, the lips pale, fingers contracted, and the nails blue. The mucous membrane of the stomach and intestines presented an inflammatory redness, and there was turgescence of the brain. The blood, bile, and the muscles, had a deep violet colour. (Ed. Med. and Surg. Jour. xxii. 232.) The following case occurred to Mr. Chavasse, of Birmingham. A druggist swallowed by mistake half an ounce of "almond flavour." In half a minute he fell down in a state of syncope: his face being deadly pale, and his pulse imperceptible After a few minutes, he came to himself and vomited some undigested food and bile, strongly impregnated with the odour of bitter almonds. Delirium, with slight convulsions came on; he then became sensible, and conversed upon his condition; but again gradually relapsed into delirium, his eyes being prominent and brilliant. In a few minutes, he again became sensible, and slowly recovered from the effects of the poison. The quantity of "almond flavour" which he had taken, was estimated to contain about half a drachm of the essential oil. I cannot avoid remarking, that we have here another instance of the disgraceful state of medical police in this country, in the fact that a deadly poison like this, is allowed to be sold by druggists for the purpose of giving flavour to pastry and liqueurs. In the above case *thirty drops* of the essential oil were taken without destroying life, although the patient had a very narrow escape. Dr. Bull of Hereford has communicated to me a case in which less than twenty drops (*seventeen*) destroyed the life of a woman, aged forty-nine, in half an hour. For an interesting case of poisoning by the Ethereal oil, with a full account of the post-mortem appearances, by Merzdorff, see Horn's Archiv. für medicin. Erfahrung. 1823. B 2. S 60. And for a case of poisoning by bitter almonds see Chemist, May, 1845.

Is the vapour of this oil sufficient to produce fatal effects? This question was raised in the subjoined case, which occurred in London, in 1838. The deceased, the wife of a publican, had been clearing out a closet, which contained, among other liquors, a bottle of the essential oil of bitter almonds. She was suddenly heard to call out. A servant found her pale and faint, and she complained of sickness. There was a strong odour in the room, and deceased said that the corks of some of the bottles had come out, and the smell had made her feel sick. She was removed to bed, but died before any medical assistance could be obtained. There was no motive for the deceased committing suicide, and it was a subject of inquiry, whether the vapour alone might not have caused death. This question was set at rest by an inspection of the body; some of the poison was found in the stomach, and there was a very strong odour

of bitter almonds in the contents. It was, therefore, clear that the deceased must have swallowed a portion of the poison, whether from motives of curiosity or not, it is impossible to say. The medical witness in answer to a question properly stated, that less than a teaspoonful might cause the death of an adult. The vapour may produce vertigo and stupor; but unless long respired, it would not be likely to cause fatal effects. In 1837-8, there were four cases of poisoning by this oil. This poison is sold to the public in quantities of not less than a quarter of an ounce at the rate of five shillings per ounce. The liquid called almond flavour, spirit of almonds or essence of peach-kernels contains half a drachm of the essential oil to one ounce of spirit. It is sold in quantities of not less than a quarter of an ounce at the rate of one shilling per ounce.

A case of poisoning by the oil of bitter almonds occurred at Hornsey, in February 1843, which shows that when the person is seen soon after death, there may be no odour about the mouth; and that an inspection is absolutely necessary in order to determine the cause of death. A chemist was found one morning, lying dead on the floor of his shop. The surgeon who was first called, a few hours after death, suspected that the deceased had taken poison, because he saw on a shelf near the body, a bottle which had contained essential oil of bitter almonds. There was, however, no odour about the mouth, and this led to the opinion, that the deceased had died from disease of the heart. The body was subsequently inspected, and it was soon rendered evident from the powerful odour which escaped from the cavities, that the deceased had died from the effects of the oil of bitter almonds. All the viscera were in a healthy state. (Med. Gaz. April 7, 1843.)

Another case of poisoning by this oil occurred at Guy's Hospital in May 1843. A boy, aged twelve, was accosted by another in the street. The latter had a medicine basket on his arm, and from this he took a bottle and offered to the boy some liquid which he called almond oil. The boy thought that he swallowed about a table-spoonful; he experienced shortly afterwards a burning sensation in his throat, and in about ten minutes, he sat down on a door-step, and became insensible. About eight minutes after he was thus found, he was brought to the hospital. His breath smelt strongly of bitter almonds; there were violent tetanic convulsions, with complete opisthotonos; the head and neck being drawn backwards, the elbows drawn behind his back, and firmly fixed in that position. The jaws were quite fixed; there was complete insensibility, and the pulse was scarcely perceptible. The treatment consisted in cold affusion to the spine and the use of the stomach-pump. The stomach was well washed out with a large quantity of water, and this smelt strongly of bitter almonds. During the treatment, the patient suffered from strong convulsive twitchings of the muscles. In about an hour he recovered, and in the course of a few hours left the hospital. It is very probable that in this case, the boy swallowed a portion of what is called almond flavour, a diluted solution of the essential oil. The contents of the stomach were submitted to two distillations, and about four ounces of a clear liquid, smelling strongly of bitter almonds, were procured. This liquid was scarcely rendered cloudy by nitrate of silver, and the iron test gave no trace of Prussian blue. The only proof, therefore, of the nature of the poison, was, the odour of the essential oil, which was very powerful, notwithstanding the want of action in the tests.

A third case of poisoning by this substance has lately occurred, and is reported by Mr. Smith of Clifton, (Lancet, June, 1844.) A girl, between 8 and 9 years of age, swallowed about a teaspoonful of a mixture sold by druggists as "ratafia," composed of one part of the essential oil of bitter almonds to seven parts of spirit. The quantity swallowed by the patient was equivalent to about *seven drops* of the essential oil. With this datum it will

be interesting to consider the effects produced by so small a dose. When seen immediately after the accident, there was complete insensibility; the eyelids were closed, but the eyes were brilliant and glassy, without any mental expression; the pupils dilated; no pulse at the wrist; the carotids beating fully and quickly; relaxation of the muscles of the extremities, but the lower jaw was clenched in rigid spasm. Cold affusion with stimulants, stimulating frictions and emetics, were employed. Vomiting was induced, and the ejecta had a strong smell of prussic acid. In about twenty minutes the pulse returned,—the child opened her eyes, and was able to answer questions. This case shows that a small dose of the oil may give rise to very alarming symptoms; and it is probable, that but for the active and prompt treatment adopted this child would have died.

CHEMICAL ANALYSIS.—This oil, often called peach-nut oil, has a pale yellow colour, and a strong odour of bitter almonds, by which it is at once identified. It gives a greasy stain when dropped on paper, which does not entirely disappear on the application of heat. It sinks in water and readily combines with alcohol; and the only test required, is to add to the alcoholic liquid, a small quantity of caustic potash, and a solution of green sulphate of iron. Prussian blue is formed on agitating the mixture, but is not well brought out, until any precipitated oxide of iron is dissolved by the addition of diluted sulphuric or muriatic acid. One drop of the oil is sufficient for this experiment. Water will separate a small portion of prussic acid from the oil. Thus, by agitating in a tube about one drachm of the oil, with three or four drachms of distilled water, and after a few minutes, filtering through a *wet* filter, the oil is entirely separated. The liquid which passes through is scarcely acid; it is rendered cloudy by nitrate of silver, and gives a decided blue-coloured precipitate with the sulphate of iron and caustic potash. The oil and prussic acid may be more completely separated by distillation with lime and water, although it is probable that all the prussic acid is not obtained by this process. Nevertheless, if the oily product of the distillation be filtered through a wet filter, a clear aqueous liquid is obtained, giving an abundant precipitate with the silver test, and well-marked effects with the sulphate of iron and potash. It is worthy of remark, that the filtered liquid, after entire precipitation by nitrate of silver and oxide of iron has the odour of bitter almonds just as strongly as before; and that the water holds some organic matter, is proved by the surplus nitrate of silver causing it to assume a violet tint, when it is exposed to the light of the sun. This odour is so persistent that it will commonly be found in the body after death. By the use of the nitrate of silver placed over a vessel containing the oil, I have procured cyanide of silver, and from this Prussian blue by the process already described for prussic acid. (p. 253.)

NOYAU, CHERRY RATAFIA, and all liqueurs having the smell of bitter almonds, are considered to be poisonous when taken in large doses. The quantity of prussic acid present in them, is liable to vary; it may be separated by distillation at a gentle heat and then tested. I have found that an ounce and a half of good noyau having a strong odour and flavour when distilled to two-thirds, yielded scarcely a trace of prussic acid either by the silver or iron test. It had been kept some time in a well-closed bottle. An equal quantity of cherry ratafia similarly treated gave me no ponderable quantity of Prussian blue.

LAUREL-WATER. CHERRY LAUREL-WATER.—This is a very weak solution of prussic acid, containing only about one-fourth of a grain per cent. of the strong acid, but it is stated to be more poisonous than this quantity of acid would indicate. (Pereira, ii. 1542.) In some specimens, which I procured by distilling the bruised tops and fine shoots of the laurel with water, the odour was powerful but the

proportion of prussic acid present was considerably less than this. It is a limpid colourless liquid, possessing a strong odour of bitter almonds, and producing, in large doses, the usual effects of poisoning by prussic acid. CHERRY LAUREL OIL.—By distillation, the leaves of the plant yield also an essential oil, resembling that of the bitter almond, but much weaker, as it contains on an average less than three per cent. of prussic acid. According to Christison, almost every part of the plant is poisonous, but especially the leaves, flowers, and kernels; the pulp of the cherry is not poisonous. Articles of food are often flavoured with the leaves, but accidents are said to have arisen from this practice.

We seldom hear of cases of poisoning by laurel-water. In a former part of this work, I have referred to the memorable trial of Captain Donellan, in 1781, on a charge of poisoning Sir T. Boughton, by this liquid.

The prisoner, it is supposed, substituted for a purgative draught, two ounces of laurel water. Admitting that the laurel water had no greater strength than that just now assigned to it, the deceased must have taken 2·4 grains of pure hydrocyanic acid, a quantity equal to *fifty drops* of Scheele's prussic acid. The draught was administered to the deceased by his mother, Lady Boughton; she perceived that it smelt strongly of bitter almonds—the only evidence of the probable nature of the poison; for the original draught, containing rhubarb, jalap, spirits of lavender, and nutmeg water, would have had no such smell. The following were the symptoms: "In about two minutes after swallowing the draught, the deceased appeared to struggle very much, as if to keep it down, and had 'a rattling and gurgling' at his stomach. In about ten minutes, he seemed inclined to doze, and in about five minutes afterwards, he was found with his eyes fixed upwards, his teeth clenched, and froth running out of his mouth." He died in half an hour after swallowing the draught. The post-mortem examination proved nothing (antè, p. 46); no poison was detected in the body, but the inspection was not made until eleven days after death.

In making every allowance for such coincidences, in the supervention of fatal disease at the time of taking medicine or food, as have elsewhere been pointed out, I do not think there is any reason to doubt that in this case the deceased was poisoned and the prisoner properly convicted. It has been urged that the medical evidence was of itself insufficient; and that without the moral circumstances, the charge of poisoning could not have been made out. But it is impossible to divide evidence in this way; it is like separating two series of circumstances in presumptive evidence, either of which taken separately may be weak, but when taken together, become strong. Many convictions on medico-legal trials for murder by poisoning, would not have occurred if the fact had rested on moral or on medical evidence *alone*. In Donellan's case, the medical evidence was strong, whether we regard the time of the occurrence of symptoms, their character, or the period within which death took place. To exclude all notion of these effects depending on a draught just before taken, and having the decided odour of a liquid known to be capable of producing them; an odour which the originally prescribed draught could not possibly have had,—and to refer them to a disease, unusual in so young a subject, and unlikely to have caused death so rapidly, or under the symptoms witnessed, is to create impunity for the cunning and skill often displayed in murder by poison. *Direct* evidence can rarely be obtained in such cases,—the murderer, unless insane, does not proclaim to the world his intention to poison another, nor the nature of the poison used, nor does he administer it openly. Every minute circumstance, therefore, requires the closest watching and analysis, if we wish to prevent by punishment, this most detestable crime. In several

cases, which have occurred since that of Donellan, the medical evidence of poisoning has not been stronger; but taken, as it always ought to be, with moral circumstances, it has been held sufficiently strong by Courts of law for a conviction of the accused party.

The following is the only recent case of poisoning by laurel-water, which I have found reported. About half a teaspoonful of a mixture, consisting of four-fifths cherry-laurel water, was given by mistake to an infant eight months old. The child threw its head back, was convulsed, and died in a few seconds. The laurel-water taken in this case, is said to have been stronger than usual. The body was inspected twenty-four hours after death. Nothing was observed in the brain and spinal marrow, but the stomach contained two tea-spoonfuls of a yellowish liquid without odour; and its mucous membrane was injected towards the greater curvature. No trace of prussic acid was found in the contents, but the poison was easily detected in the liquid remaining in the phial. (Med. Gaz. Jan. 1843.) For another singular case in which the symptoms came on slowly, see Med. Gaz. xxxvi. p. 105.

There are other plants, the leaves and kernels of which yield prussic acid; these are, the bird-cherry, the peach, nectarine, damson, apricot, and the seeds of apples and pears. I have examined the seeds of oranges and figs, but have found none; nor could I obtain the slightest trace of prussic acid from the distillation of three hundred grains of the sweet almond. The quantity produced from the seeds of apples has been, in my opinion, much exaggerated. The defence of Tawell has rendered this question a matter of some interest. I found that the seeds of ten apples distilled with water, with their skins *unbroken*, yielded not a trace of prussic acid. When reduced to a fine pulp and distilled with a small quantity of water,—nitrate of silver scarcely rendered the liquid cloudy, and the quantity of prussian blue obtained from the whole, was so small that it was difficult to assign an estimate to its weight. Taking it at the maximum it could not have exceeded the 150th part of a grain! The experiment was repeated with a like result. I should much doubt, from my experiments, whether the seeds of twenty apples would yield so much prussic acid as one bitter almond. The apples for these experiments were procured indiscriminately from a public market. It is possible that the proportion of prussic acid obtained may vary in different apples, but it must be in all cases small; and in no case is it likely to be formed unless the seeds are bruised or well masticated. (See Med. Gaz. xxxvi. p. 328.) For a case of poisoning by cherry kernels, see Chemist, June, 1845. Twelve ounces of these kernels are said to have yielded seven grains of hydrocyanic acid. (Christison, 794.)

A singular case of poisoning by peach-kernels has been communicated to me by Mr. Hicks of Newington, who has devoted considerable attention to the subject of poisoning by prussic acid, and to whom I am indebted for many interesting particulars. A medical man swallowed half an ounce of a liquid made by digesting gin on a large quantity of peach-kernels. He became giddy and had violent constriction of the fauces and dimness of sight. He vomited and recovered. The bottle was brought to me by Mr. Hicks,—a few drops of the liquid contained in it, yielded only a faint trace of prussian blue. The

kernels weighed 124 grains; they were large and the skins entire. All the prussic acid must have been extracted, either as such or under the form of amygdalin; for on bruising the kernels and distilling them with water not a particle of the poison could be procured!

SULPHOCYANIC and FERROCYANIC ACIDS, free or combined with potash, are said not to be poisonous, but further experiments are required on this point. A singular case, in which sulphocyanic acid was alleged to have been the cause of death, will be found in the British and Foreign Medical Review, July, 1839. A man wishing to destroy himself, swallowed a liquid, which he had obtained by distilling strong sulphuric acid with ferrocyanate of potash. He was found dead in his room, and twenty-four hours afterwards, the body was examined. The stomach was not inflamed, but part of its mucous surface was softened, and of a brownish black colour. There was no odour of prussic acid. Some doubt being entertained, as to what the products of such a distillation might be, experiments were performed; but the results obtained by the different experimentalists did not agree. In repeating the distillation, I have found that prussic acid in large, and sulphocyanic acid in small quantity, were procured; and it is highly probable that death was really caused by prussic acid, which may have been the case, although *no odour was perceptible.* The blackened state of the stomach was probably due to some sulphuric acid being mixed with it.

CYANIDE OF POTASSIUM.—This is a poisonous salt, now much used in the art of electro-gilding and plating. It is a solid, sometimes seen crystallized, at others in a white chalky-looking powder. It is without odour until put into water, when it is freely dissolved, forming an alkaline solution, from which prussic acid is abundantly evolved. It acquires a strong smell in a damp atmosphere, and becomes dark-coloured. The cyanide of potassium is used on the continent as a medicine, and it has lately occasioned the death of a person at St. Malo, under the following circumstances. A physician prescribed for the deceased rather more than one drachm of the cyanide in two ounces and a half of orange-flower water and syrup; and of this mixture, three spoonfuls were to be taken daily: it seems that table-spoonfuls were taken, and the patient died in three quarters of an hour after the first dose. None of the poison was found in the stomach; but a portion of the mixture from which the first dose had been taken was examined, and found to contain the cyanide of potassium. A criminal procedure was instituted against the physician, and he was fined and imprisoned. M. Malaguti, who gave evidence on the occasion, stated that a dog was killed in a few minutes after taking less than three grains of the cyanide in solution, and that the largest dose of this medicine to a human being was five-sixths of a grain. (Lancet, January, 1843.) The mixture in the above case, contained about three grains of the cyanide in one drachm: therefore had teaspoonfuls been taken by the deceased, he would have taken quite sufficient to destroy life. The medicine had evidently been prescribed by a person totally ignorant of its poisonous

properties. Another case occurred at Breslau in which a man, aged thirty, died in a *quarter of an hour* after taking a dose of a mixture containing fifteen grains of cyanide of potassium which had been prescribed for him by his medical attendant, under all the symptoms of poisoning by prussic acid. (Henke Zeitschrift der S. A., 1843, 7. See also Ann. D'Hyg., 1843, i. 404.)

Chemical Analysis.—Cyanide of potassium is known, 1, by the odour of its solution in water rendered more perceptible by acids; 2, by the action of nitrate of silver, which precipitates cyanide of silver soluble in excess; and 3rd, by tartaric acid or chloride of platina, which indicates the presence of potash. A solution of sulphate of iron and muriatic acid produce with it, Prussian blue. The recent introduction of this salt into the arts as a silvering liquid may easily lead to accidents. It must be regarded as highly poisonous.

Prussian blue.—This substance does not appear to possess any poisonous properties. It is said to be much employed when mixed with some yellow colouring matter, to give a green colour to factitious tea-leaves. In a seizure which was lately made of some spurious tea, a question was put by the magistrate as to whether Prussian blue was a poison. One of the parties, who gave evidence, is reported to have said that it was a decided poison:—that it consisted of iron, nitrogen and carbon, and was strongly impregnated with prussic acid! This evidence appears to have been received without any comment.

Chemical analysis.—Prussian blue is a tasteless powder of a deep blue colour, insoluble in water, alcohol, and the diluted acids. It may be idenfied by the following characters. 1. When heated in the air it turns brown and becomes incandescent. Indigo, under the same circumstances, is in great part volatilized in the form of a rich purple vapour. 2. If warmed with a few drops of caustic potash, oxide of iron is precipitated, and ferrocyanide of potassium is formed. When this liquid, neutralized, is added to a solution of sulphate of copper a deep claret red precipitate falls down. (See antè, p. 185.) 3. Its most remarkable property, and that by which it is known from all other blue compounds, is that it forms a dirty white solution when boiled with concentrated sulphuric acid; and Prussian blue is again precipitated when this solution is added to water. 4. Boiled with peroxide of mercury it yields on filtration and evaporation bycanide of mercury. Considering it as a compound of cyanogen and iron, it contains in 100 parts;—of cyanogen 54·4, iron 45.6.

CHAPTER XXIII.

NARCOTICO-IRRITANT POISONS. NUX VOMICA. STRYCHNIA. COLCHICUM. VERATRIA. CONIUM. ALCOHOL.

The general symptoms produced by the narcotico-irritants, have already been described. (See Chapter III.) It will therefore be only necessary in this place to make a few remarks on some of these poisons individually.

Nux vomica. Strychnia.—Cases of poisoning by nux vomica are not unfrequent. In 1837-8, there were three fatal cases marked in the

coroner's return, and one case of poisoning by strychnia. The poisonous properties of nux vomica are due to the presence of strychnia; the symptoms in the two cases are alike, but of course much more severe when produced by the pure alkaloid. Nux vomica is usually taken in the form of powder.

SYMPTOMS.—The powder has an intensely bitter taste, which is very persistent. In from five to twenty minutes after it has been swallowed, the patient is suddenly seized with tetanic spasms, affecting the whole of the muscular system, the body becoming rigid, the limbs stretched out, and the jaw so fixed, that considerable difficulty is experienced in introducing anything into the mouth. The muscles of the chest are also fixed by spasmodic contraction, and the body sometimes assumes the state of opisthotonos; the intellect is clear. This spasmodic state ceases, but after a short interval, reappears, and the chest is so fixed, as to give the sense of impending suffocation. After several such attacks, increasing in severity, the patient dies asphyxiated. Drowsiness and a feeling of general illness have sometimes preceded the attack; vomiting, pain in the abdomen, and other symptoms of irritation, have been occasionally witnessed where the case was protracted; but in general, death takes place long before such symptoms are manifested.

POST-MORTEM APPEARANCES.—In a well-marked case of poisoning by this substance at University College Hospital in 1839, the only appearances met with, were general turgescence of the brain and its vessels. A quantity of the powder was found in the stomach, to the mucous membrane of which it adhered very tenaciously; there was injection, with many ecchymosed points at the cardiac extremity. The brain, as well as the spinal marrow, has been found softened. The spasmodic condition of the body has been observed to continue after death, and to pass into the state of cadaverous rigidity.

With respect to the QUANTITY required to destroy life,—according to Christison, the smallest dose yet recorded, is three grains of the alcoholic extract; but it is not stated to how much of the powder this would correspond. Two cases occurred in London, in 1839, in each of which fifty grains of the powder (equal to one-fourth of a grain of strychnia) proved fatal. In one of these cases, death took place in an hour; the chemist who sold the poison said that he did not think a dose of fifty grains was sufficient to cause death; but a much smaller quantity has been known to destroy life. One case proved fatal, where thirty grains of the powder were taken in two doses; (Christison, 901;) and in another reported by Dr. Traill, *fifteen grains* destroyed life; this is probably *the smallest* fatal dose yet known. (Outlines, 137.) Death usually occurs in from one to two hours; but Dr. Christison mentions a case where a man died in *fifteen minutes* after taking a dose. (988.) This is probably the shortest period. There are several instances of recovery on record. Sobernheim mentions the case of a young man, who took half an ounce of the powder, and suffered from the usual symptoms; emetics were ad-

ministered, and he recovered. A second occurred to Dr. Basedow, of Merseburg. A young lady swallowed, by mistake, a tablespoonful of the powder; she was almost instantly deprived of the power of walking, and fell down, but did not lose her recollection. There was great difficulty of breathing. Emetics were administered with good effect, and she recovered. A third case is described by Mr. Baynham, of Birmingham. A girl aged twenty, swallowed half an ounce of the powder. In half an hour the usual tetanic symptoms came on, but she was perfectly sensible. In administering remedies, the spasm of the muscles of the jaw, was such as to cause her to bite through the cup. The convulsions gradually subsided in about four hours from the first attack, and the next day, although feeble and exhausted, she was able to walk home. (Med. Gaz. iii. 445.) The reporter of this case, states that he has often prescribed a scruple of powdered nux vomica daily, without any injurious effects following! It may be proper to mention in this place that nux vomica in powder is retailed to the public at eightpence an ounce.

Treatment.—The removal of the poison from the stomach by emetics, or the use of the stomach-pump, must be chiefly relied on. Unless these means be employed early, the jaw may become spasmodically fixed, so as to render all efforts at relief unavailing. In general, however, the spasms have intermissions, so that there may be time to apply remedies in the interval.

Strychnia and its salts.—The symptoms produced by strychnia, closely resemble those described in speaking of nux vomica. The following case is reported in the Lancet, (Jan. 7, 1838.) A young man, aged seventeen, swallowed forty grains of strychnia. The symptoms came on in about a quarter of an hour; trismus and spasmodic contraction of all the muscles speedily set in; the whole body becoming as stiff as a board; the lower extremities were extended and stiff, and the soles of the feet concave. The skin became livid, the eyeballs prominent, and the pupils dilated and insensible; the patient lay for a few minutes without consciousness, and in a state of universal tetanus. A remission occurred, but the symptoms became aggravated, and the patient died asphyxiated from the spasm of the chest, in about an hour and a-half after taking the poison. On inspection, twenty hours after death, the body was very rigid. There was effusion in the spinal sheath, and the upper part of the spinal marrow was softened; the brain was congested, but the alimentary canal was in its normal state.

With respect to the *quantity* of strychnia required to destroy life, Dr. Christison thinks that half a grain thrust into a wound, would destroy a man in a quarter of an hour. Three-eighths of a grain given medicinally, produced violent tetanic convulsions, spasms of the extremities, trismus, opisthotonos, spasmodic fixing of the chest, and all the other formidable symptoms usually produced by the alkaloid. (Ed. Med. Surg. Jour. 49, 327.) Half a grain given three times a day for several days caused death under the usual symptoms. (Pereira, ii. 1310.) Thus we see that this substance, which is almost insoluble,

requiring seven thousand parts of water to dissolve it, is capable of exerting a powerfully poisonous action. The quantity required to destroy life when swallowed, is not known. My friend, Mr. J. G. French, informed me of a case, where a person took medicinally a *grain* of strychnia; vomiting supervened, and in the course of a few hours she recovered. This must be regarded as an unusually large dose, to be followed by recovery; since it is very probable that half a grain might in some cases prove fatal. When medicinally employed and the dose is gradually raised, the system may become habituated to the poison so as to resist the effects of very large doses. As much as three grains have been taken daily for some time by a patient without dangerous consequences. (Gaz. Medicale, Mar. 1845.) The ordinary medicinal dose is from the sixteenth to the eighth of a grain.

The symptoms produced by strychnia very much resemble those of tetanus; but in the last-mentioned disease the symptoms are more slowly formed, and can only be coincidentally connected with the taking of some kind of solid or liquid. Death is a much more rapid effect of the poison, than of the disease as it is produced by natural causes. Medical men may, however, be easily deceived respecting the origin of the symptoms, when the dose is small and frequently repeated. A few years since, an action was brought against an Insurance company, to recover the amount due on a policy for the life of a young lady. She died under very suspicious circumstances, after several insurances on her life had been effected by the plaintiff in the cause. The party did not recover in the action, and he ultimately fled the country; it was rendered probable afterwards, that he had destroyed the deceased by administering to her strychnia in porter.

The Bean of St. Ignatius, the Wourali poison, and the Upas tieuté, owe their poisonous properties to this alkaloid. The former is said to contain from 1·2 to nearly 2 per cent of strychnia, a quantity three times as great as that found in nux vomica.

Chemical analysis.—Nux vomica is well known as a flat round kernel, less than an inch in diameter, with radiating fibres, slightly raised in the centre. It is of a light brown colour, and covered with a fine silky down. It is very hard, brittle, tough, and difficult to pulverize. The powder is of a grey brown colour, like that of liquorice: it is sometimes met with in a coarsely rasped state:—it has an intensely bitter taste. It yields to water and alcohol strychnia, brucia, igasuric or strychnic acid, and some common vegetable principles. Heated on platina foil, it burns with a smoky flame. Nitric acid turns it of a deep orange-red colour, which is destroyed by protochloride of tin. The aqueous infusion is similarly changed by nitric acid, and it is freely precipitated by tincture of galls. The quantity of strychnia contained in the powder has not been very accurately determined. It probably amounts to about 0.5 grain or one-half grain per cent. If this be the case, the strychnia is more energetic when contained in the nut, than when separated.

When nux vomica has been taken in the form of powder, we can only identify it in the stomach by demonstrating the presence of its strychnia. As the powder is quite insoluble in water, it may generally be separated by decantation.

Various processes have been suggested for the detection of strychnia in nux vomica; but owing to the very small quantity of the poisonous alkaloid contained in it, it is obvious that, unless we have a large quantity of the powder

to examine, none of these are likely to succeed. Fifty grains of the powder will not yield more than one quarter of a grain of strychnia. The following is, perhaps, the most simple process: Boil the powder in alcohol of about seventy per cent., until nothing further is dissolved. Evaporate to an extract, and boil this in water with a small quantity of calcined magnesia. Strychnia, mixed with brucia, is thereby precipitated: and may be separated from the magnesia in the insoluble residue, by further digestion in boiling alcohol. This alcoholic liquid yields strychnia, which may be purified in the usual way. There are no chemical characters by which the acid, united to the strychnia, can be readily identified; and thus this process is more defective than that for morphia, since we acquire so much more certainty, where, besides the poisonous base, we can show by tests the presence of the peculiar acid with which the base is known to be united. Another method of separating strychnia, is by making an aqueous infusion with very dilute sulphuric acid, and afterwards precipitating the strychnia by boiling the filtered liquid with lime. The aqueous infusion of nux vomica gives the same bright red tint with nitric acid, as the infusion of opium; but it is known from the latter by its giving a green instead of a deep red colour with the permuriate of iron; also by the action of chloride of tin as above mentioned. Infusion of galls precipitates it abundantly.

Strychnia is known by the following properties: 1. It may be met with, crystallized in short prisms, or in the state of a greyish white powder. 2. It is scarcely soluble in water, hot or cold;—it is not very soluble in alcohol, but is dissolved by ether. 3. When heated on platina foil, it melts, becomes charred, and burns with a black smoky flame, leaving a residue of carbon. This experiment should be performed with caution, and on the smallest quantity:—if the vapour be respired, it might give rise to alarming symptoms. 4. When the crystals are dropped into strong nitric acid, they become partially dissolved, without evolving deutoxide of nitrogen, and the liquid acquires a deep red colour. This colour is immediately destroyed by protochloride of tin; but if allowed to remain exposed to air, it slowly acquires a dark greenish brown hue. This red colour, thus given by nitric acid, appears to be caused by the presence of brucia. I have, however, found it to be produced in all the specimens of uncombined strychnia which I have tried; and it is pretty certain, that no specimen of strychnia is ever likely to come before a medical jurist in practice, which does not possess the property of being turned red by nitric acid, although pure strychnia and its salts are certainly not thus affected by nitric acid. 5. If to strychnia in water a few drops of a diluted acid (sulphuric) be added, it is readily dissolved on boiling,—crystals being sometimes deposited on cooling. 6. This solution is precipitated by tincture of galls. 7. It is precipitated white by alkalies (ammonia). 8. It is precipitated yellow by chloride of gold, while a salt of morphia gives with this test, a purple brown precipitate. 9. It is coloured red by nitric acid;—the colour being discharged by protochloride of tin. 10. It is not affected by permuriate of iron, or by iodic acid and starch,—characters whereby it is easily known from morphia. 11. Potash precipitates a salt of strychnia readily, and the precipitate is insoluble in the alkali: it only precipitates a salt of morphia when much concentrated, and the precipitate is immediately dissolved by an excess. It has lately been proposed to digest the alkali in sulphuric, mixed with nitric acid, and add peroxide of lead. A blue colour appears, passing to violet blue and yellow. This test requires further investigation.

COLCHICUM. COLCHICINA. (MEADOW SAFFRON.) WHITE HELLEBORE. VERATRIA. The roots and seeds of these plants and the leaves and flowers of colchicum exert a violent action on the human subject, chiefly manifested by symptoms of irritation in the alimentary canal. With a burning pain in the throat and œsophagus, there have been violent vomiting and purging, and death in the course of some hours. After death,

the stomach has been found inflamed, but not in all instances. In November, 1839, a gentleman swallowed by mistake one ounce and a half of wine of colchicum. He was immediately seized with severe pain in the abdomen: other symptoms of irritation came on, and he died in seven hours. No post-mortem examination was required by the coroner! In another instance in which an ounce was taken, death occurred in thirty-nine hours. (Schneider's Annalen, i. 232.) In a well-marked case of poisoning by the wine of colchicum, reported by Mr. Fereday, two ounces were taken. The symptoms did not come on for an hour and a half; there was then copious vomiting of a yellow fluid, severe pain with great tenderness in the abdomen, tenesmus and thirst. The patient died in forty-eight hours without manifesting any sign of cerebral disturbance. The chief morbid appearance, was a patch of redness in the mucous membrane of the stomach, near the cardiac orifice; the intestines were slightly inflamed. In another case where an ounce and a half of the tincture was taken, and death ensued in forty-eight hours, no morbid appearances were found. A man, aged fifty-two, took a decoction, made with a tablespoonful of colchicum seeds to a pint and a half of water. He was seized with vomiting and purging continuing incessantly until death, which took place in about thirty-six hours. The only appearance of note, was that the stomach had a violet or purple hue. An interesting case of poisoning by the medicinal administration of colchicum has been lately communicated to me by Mr. Mann of Bartholomew Close. Three and a half drachms of the wine of colchicum were taken in divided doses and caused death on the fourth day. There was no inflammation of the mucous membrane, but simply extravasation of blood into the mucous follicles.

Colchicum and white hellebore owe their poisonous properties to the alkaloids *colchicina* and *veratria* which are powerful poisons when separated. But little is known concerning their action. A medical friend communicated to me the following fact. A physician prescribed medicinally for a lady, one grain of veratria divided into fifty pills, and three were directed to be taken for a dose. Not long after the first dose had been swallowed, the patient was found insensible, the surface cold, the pulse failing, and there was every symptom of approaching dissolution. She remained some hours in a doubtful condition, but ultimately recovered. Supposing the medicine to have been well mixed, and the pills equally divided, not more than one sixteenth of a grain of veratria was here taken. This, at any rate, proves, that the substance is a very active poison. The medicinal doses of the vinegar and wine of colchicum are from half a drachm to a drachm,—of the tincture from twenty minims to thirty, and of the powder from two to eight grains.

Digitalis. Digitalin. (Foxglove.)—This plant, whether in the form of powder, extract, tincture, or infusion, is a poison, acting both on the brain and alimentary canal. The leaves appear to have the

most powerful action. One of the best marked cases of poisoning by this plant, became the subject of a criminal trial at the Old Bailey in Oct. 1826. A quack was indicted for the manslaughter of a boy under the following circumstances. He prescribed for a trivial complaint, six ounces of a strong decoction of digitalis. The boy was soon attacked with vomiting, purging, and severe pain in the abdomen. After some time, he became lethargic and slept for several hours; in the night he was seized with convulsions. The pupils were dilated and insensible, the pulse slow, small and irregular; coma followed, and the boy died twenty-two hours after the taking of the poison. On inspection, the membranes of the brain were found much injected, and the mucous lining of the stomach was partially inflamed. The prisoner was acquitted of the charge, because he had only given his advice on the application of the friends of the deceased! (Ed. Med. and Surg. Jour. xxvii. 223.) For a case of recovery from a strong dose of the infusion, see Med. Gaz. xxxiv. 659. Accidents sometimes occur from the medicinal use of the tincture. In a late number of the Medical Gazette, is the account of a case, where from a dose of the tincture too frequently repeated, the person was attacked with restlessness, thirst, inflamed conjunctivæ, and other serious symptoms. The medicinal dose of the infusion is from half an ounce to one ounce:—of the tincture, from ten minims to forty:—of the powder, from half a grain to one grain and a half.

Conium maculatum. (Common hemlock.) Cicuta virosa. (Water hemlock.) Æthusa Cynapium. (Fool's-parsley.) Œnanthe-crocata, (Hemlock water-dropwort.)—The leaves and roots of these plants have frequently given rise to accidents. The symptoms which they produce are dimness of sight, vertigo, delirium, swelling, with pain in the abdomen, vomiting and diarrhea. Convulsions are sometimes observed. Death commonly takes place rapidly, and the post-mortem appearances are slight; sometimes amounting merely to congestion of the brain, with slight inflammatory redness of the stomach and bowels. The Œnanthe crocata appears to be the most fatal among these plants. In February, 1834, four convicts at Woolwich lost their lives by eating the roots of this vegetable, which they had mistaken for parsnips. One died in less than an hour. For an account of these cases, see Med. Gaz., May, 1844. On inspection, their stomachs were found completely filled with slices of the root. Ten others who had also partaken of the root suffered severely, but recovered. This is one of the most virulent of English vegetable poisons. It is found growing abundantly in the South of Ireland. Dr. Pickells has collected thirty cases of death from the eating of the root,—the quantity taken in one instance did not exceed the top of the finger in size. The symptoms were insensibility, tetanus, delirium and insanity. Dr. Christison has not found this plant, growing in Scotland to be poisonous; but it is an active poison as it grows in England, Wales and Ireland.

The following is a case of poisoning by the Æthusa cynapium, reported in a late number of the Medicinsches Jahrbuch. A woman gave two of her children some soup, in which she had boiled the root of this plant, mistaking it for parsley. They were both seized with severe pain in the abdomen, and the next morning, one of them, a boy, aged eight years, was in a state of perfect unconsciousness, and his jaws were spasmodically fixed. The abdomen was swollen; there was vomiting of bloody mucus, with obstinate diarrhea,—the extremities were cold, and the whole body was convulsed. He died in twenty-four hours. The only appearances met with, were redness of the lining membrane of the œsophagus and trachea, with slight vascular congestion of the stomach and duodenum. For a recent and very interesting case of poisoning by Conium, by Dr. Bennett, I must refer the reader to the Ed. Med. and Surg. Journal, July, 1845, p. 169.

Datura stramonium. Daturine. (Thornapple.) The following case reported by Mr. Mash of Northampton, may be taken as an example of the effects produced by this plant, all the parts of which, but especially the seeds and fruit, are poisonous. A woman, aged thirty-six, took two teacupfuls of infusion of stramonium, by mistake for senna tea. In about ten minutes she was seized with giddiness, dimness of sight, and fainting. In two hours she was quite insensible, the pupils were fixed and dilated; all the muscles of the body convulsed, the countenance flushed, and the pulse full and slow. The stomach-pump was applied, and in the course of a few hours she recovered, suffering, however, from indistinctness of vision and vertigo. (Med. Gaz. viii. 605.) The seeds of this plant have been known to produce furious delirium; and a case is mentioned by Sauvages of an old man of sixty, who, after taking this poison, became intoxicated, manaical, and lost the power of speech. He remained in a lethargic state for five hours. Several fatal cases are reported, one of which terminated in six hours. Dr. Thomson relates the case of a child, aged two years, who swallowed sixteen grains of the seeds. Maniacal delirium supervened; the symptoms resembled those of hydrophobia, and death took place in twenty-four hours. This plant has been used by robbers for the purpose of stupifying those whom they intend to attack. A very interesting medico-legal case of poisoning by thornapple will be found reported in Henke's Zeitschrift der S. A. 1837, i. H.; and another in the Lancet, April, 1845. Dr. Zechmeister has lately reported the case of a boy, aged five years, from which it would appear that the vapour of the full-blown flowers, is capable of giving rise to well-marked symptoms of poisoning. (Oesterreich. Med. Wochenschr. 19 Juli, 1845.)

Aconitum napellus. Aconitine. (Monkshood. Wolfsbane. Blue-rocket.) Two deaths are recorded to have taken place from this poisonous plant in 1837-8. The root, seeds and leaves contain a most active poison, *aconitine*, to which the properties of the plant are due. These parts of the plant possess a hot acrid taste, and give rise to a burning sensation in the fauces, numbness and tingling in the limbs swelling and pain in the abdomen, vomiting and diarrhea,

accompanied by vertigo, delirium, dimness of sight and other symptoms, indicative of cerebral affection. In 1842, a lady, residing at Lambeth, was poisoned by her having eaten the root in mistake for horse-radish with some roast beef. It is not likely, that under these circumstances, much could have been eaten; but very shortly after dinner, slight vomiting came on, with severe pain in the abdomen. Emetics and the stomach-pump were used, but she died in three hours.

In the hospital at Bordeaux, five grains of fresh extract of aconite were given to three patients. One of them died in three hours. In a quarter of an hour after taking the poison, the patients had tremors of the muscles, and a pricking sensation over their bodies; severe vomiting followed. They became quite unconscious; and on recovering their senses, there was confusion of sight with intense headache; the skin was cold and clammy, the pulse slow and irregular, and the respiration short and hurried. Two of the patients recovered. (Med. Chir. Rev., Oct., 1839, 544.) The most complete medico-legal history of poisoning by aconite, has been given by Dr. Geoghegan, of Dublin, in the Dublin Medical Journal. See also the treatise of Dr. Fleming, London, 1845.

A trial for murder by poisoning, took place at the Monaghan Lent Assizes in 1841, in which Dr. Geoghegan was a witness for the crown. The medical evidence was beset with difficulties; for no trace of poison could be discovered, and it was only by a close analysis of symptoms and post-mortem appearances, that the charge was brought home to the prisoner. The deceased had eaten for his dinner some greens dressed for him by the prisoner; he complained of their having a sharp taste, and this was perceived also by another person present, who tasted them. It was ascertained, that the deceased, soon after the meal, had vomited a greenish matter, and suffered from diarrhea, restlessness, incoherence, trismus and clenching of the hands. He died in about three hours after having eaten the greens, but was not seen by a medical man while living. The chief appearance met with, was in the stomach, where the mucous membrane was of a light reddish brown colour. Traces of vegetable matter were found in the intestines: but no poison could be detected either botanically or chemically. The symptoms suffered by the person, who had accidentally tasted the greens, were very characteristic of poisoning by aconite. In *two* minutes, he felt a burning heat in the mouth, throat, gullet and stomach; then a sensation of swelling in the face, a general feeling of numbness and creeping of the skin. Restlessness, dimness of sight and stupor, almost amounting to insensibility, followed; and about an hour after the meal, he was found speechless,—frothing at the nose and mouth, the hands and jaws clenched, appearing occasionally as if dead, and then again reviving. Vomiting, purging, tenderness of the epigastrium, cramps, tingling of the flesh, and a burning taste in the mouth, followed. He did not entirely recover after the lapse of five weeks. The prisoner was convicted of murder, and confessed before execution that the root of aconite, had been mixed with pepper and sprinkled over the greens. From this case we learn that the actual discovery of a poison is not insisted on by a Court of law, when the medical and general evidence is conclusive of the fact of poisoning. Dr. Geoghegan quotes two other instances of poisoning by aconite, one of a man aged fifty-six, who died in an hour and a quarter after eating the root;—and the second, a boy aged seven, who died in two hours, having been much convulsed before death. One drachm of the root is said to have proved fatal; but it is probable that less than this would suffice to kill an adult. There appears to be considerable uncertainty in the operation of this poison under the form of tincture. In a case which occurred to M. Devay, (Cormack's Edinburgh Journal, April, 1844,) a man recovered in three days after having taken upwards of ten drachms of

the tincture, (only infused for a day,) while the late Dr. Male of Birmingham, is reported to have died from the effects of not more than eighty drops taken in ten doses, over a period of four days,—the largest quantity taken at once being *ten* drops. (Prov. Med. and Surg. Journ., August 20, 1845, p. 535, also Med. Gaz. xxxvi. 861.) Dr. Pereira informs me that he has known general numbness produced in hysterical females by a dose of only *five minims* of a carefully prepared tincture. The alkaloidal base of this plant, *aconitine*, is a most formidable poison, exceeding all others in its effects: according to Dr. Pereira it is strongly retained in the vegetable tissues after their compression. Hence the uncertainty of the preparations of aconite.

ATROPA BELLADONNA. ATROPINE. (DEADLY NIGHTSHADE.) This plant is poisonous in its root, leaves and berries. Children have frequently suffered severely from eating the shining black berries of the belladonna. The symptoms observed have been dryness of the throat and fauces,—vertigo, delirium, convulsions, sopor, and lethargy; sometimes vomiting and nausea exist. There have been but very few instances known of this poison proving fatal, consequently there are very imperfect accounts of the morbid appearances. It has been supposed that the delirium, produced by it, preceded the lethargic state; but from a case published by Mr. Clayton, where a man took forty grains of the extract and recovered, the sopor preceded the delirium, which did not come on until six hours after the administration of the poison. A case occurred at St. George's hospital, under Sir B. Brodie, in which an ounce of the extract of belladonna was taken, and the person recovered. This is not, therefore, so active a poison as its common name would imply; it is much less virulent than some of the other narcotico-irritants. One death occurred from it in 1837-8. Dr. Scharf has lately published a case of poisoning by the root of belladonna infused in four ounces of water and injected as a clyster. In a very short time the patient fell into a state of complete narcotism and died in five hours. (Casper's Wochenschrift, Februar. 1845.

NICOTIANA TABACUM, NICOTINA (TOBACCO.) This plant, according to late researches, contains a poisonous alkaloidal principle, nicotina intimately combined with an essential oil. Tobacco has proved fatal, when used improperly or by mistake, in the form of an injection; but very little is known concerning the few cases in which it has destroyed life. The symptoms have been nausea, vomiting, vertigo, convulsions and coma, followed by death in a few hours. In one case it destroyed life in three quarters of an hour.

MENISPERNUM COCCULUS. PICROTOXINE. (COCCULUS INDICUS.)—This is the fruit or berry of the Menispernum Cocculus, imported from the East Indies. It contains from one to two per cent. of a poisonous alkaloid (*picrotoxine.*) The seeds give rise to vomiting and griping pains, and a decoction of them produces stupor and intoxication. There is, so far as I am aware, only one well-authenticated instance of this substance having proved fatal to man. (See Traill's Outlines 146.) London porter and ale are considered, and, in some instances with propriety, to owe their intoxicating properties to a decoction, or

extract, of these berries, a fraud not readily susceptible of detection. Cocculus indicus is also used by robbers to intoxicate their victims, and to this form of intoxication, the term hocussing is applied. This substance is applied to no useful purpose whatever, either in medicine or the arts; and, under a proper system of medical police its importation would be strictly prohibited.

Cytisus Laburnum.—The bark and seeds of the common laburnum contain an active poison called *cytisine*. Dr. Traill met with two cases of poisoning by the seeds and an interesting case has been more recently reported by Dr. Christison, (Ed. Med. and S. J. Oct. 1843,) which was the subject of a trial at Inverness. A youth, with the intention merely of producing vomiting in one of his fellow-servants, a female, put some dry laburnum-bark into the broth which was being prepared for their dinner. The cook, who remarked a "strong peculiar taste" in the broth, soon became very ill, and in five minutes was attacked with violent vomiting. The account of the symptoms is imperfect; for the cause of them was not even suspected until six months afterwards. The vomiting continued thirty-six hours; was accompanied by shivering,—pain in the abdomen, especially in the stomach,—and great feebleness, with severe purging. These symptoms continued, more or less, for a period of eight months; and she fell off in flesh and strength. At this period she was seen by a physician, who had been called on by the law-authorities to investigate the case. She was then suffering from gastro-intestinal irritation, vomiting after food, pain in the abdomen—increased by pressure, diarrhea, tenesmus, and bloody stools, with other serious symptoms. The medical opinion was, that she was then in a highly dangerous state. The woman did not eventually recover until the following April. There was no doubt, from the investigation made by Dr. Ross and Dr. Christison, that her protracted illness was really due to the effects of the laburnum-bark.

Some experiments were then made on the action of the poison on animals. A teaspoonful of the powder of dry laburnum-bark was administered to a cat. Soon afterwards it writhed, apparently in great pain; in a short time it vomited violently, and, although languid and dejected for the rest of the day, it quickly recovered. Sixty-nine grains of the same powder were given to a dog. In ten minutes it whined and moaned, vomited violently, and soon got well. On a second occasion, twenty grains were found to act as a powerful emetic upon the animal. An ounce of the infusion of laburnum-bark, containing the active matter of sixty-two grains, was introduced by a catheter into the stomach of a full-grown rabbit. In ten minutes, the animal looked quickly from one side to the other, twitched back its head twice or thrice, and instantly fell on its side in violent tetanic convulsions, with alternating emprosthotonos and opisthotonos, so energetic, that its body bounded with great force upon the side, up and down the room. Suddenly, however, all movement ceased, respiration was at an end, the whole of the muscles became quite flaccid,

no sign of sensation could be elicited, and the animal died within *two minutes and a half* after the poison was injected into the stomach. The body was opened in two minutes more, and the heart was found gorged, but contracting with some force. The stomach was filled with green pulp, soaked with the infusion. No morbid appearance was visible anywhere. In repeating this experiment, one rabbit died in half an hour, another in three quarters of an hour after small doses of the infusion were injected into the stomach; and a third rabbit speedily died, after eating greens merely impregnated with the infusion. In all these instances, convulsions were the leading symptoms produced. The same effects are popularly ascribed to the leaves, young pods, and seeds of the tree; but no experiments were performed with these.

The facts here detailed show, that laburnum-bark is a most energetic poison—as powerful, even, as nux vomica. There are no chemical means of detecting the nature of this poison, especially when administered in powder or infusion; or when, as in this criminal case, a decoction of the bark is given in food. The only plan for determining the deleterious properties of the substance, would be by exhibiting a portion to animals. As Dr. Christison remarks, these facts are of considerable importance; and as they relate to a substance so common, and so easily obtained by every one, they ought to be more generally known to the profession than they appear to be at present.

Fungi. Mushrooms. Poisoning by mushrooms is by no means unusual as the result of accident. In 1837-8 there were four fatal cases of this description. There do not appear to be any satisfactory rules for distinguishing those mushrooms which are wholesome from those which are poisonous. The best test is that assigned by Dr. Christison—namely, that the poisonous vegetable has an astringent styptic taste; and perhaps also a disagreeable but certainly a pungent odour. The narcotic poisonous principle is called *fungin*, but its nature and properties are but imperfectly known. These fungi act sometimes as narcotics, at others as irritants. It is difficult to generalize where observations are so limited; but it would appear from the reports of several cases which I have collected, that when the narcotic symptoms are excited, they come on soon after the meal at which the mushrooms have been eaten, and they are manifested by giddiness, dimness of sight and debility. Dr. Peddie has related three cases of poisoning by mushrooms, (Ed. M. & S. J. xlix., 200,) in which the poison acted as a pure narcotic; there was no pain in the abdomen, nor irritation in the alimentary canal. The narcotic symptoms began in half an hour with giddiness and stupor. The first effect with one patient was, that every object appeared to him to be of a blue colour. The three patients recovered, two of them rapidly. When the drowsiness passes off, there is generally nausea and vomiting.

If the symptoms do not occur until many hours after the meal, they partake more of the characters of irritation;—indicated by pain and swelling of the abdomen, vomiting and purging. Several cases, in which the symptoms did not appear until after the lapse of fourteen hours, are reported in the Medical Gazette (vol. xxv. p. 110.) In some instances, the symptoms of poisoning have not commenced until after the lapse of thirty hours; and in these, narcotism followed the symptoms of irritation. It might be supposed that these different effects were due to different properties in the mushrooms; but the same fungi have acted on members of the same family in one case like irritants, and in another like narcotics In some persons, even the edible mushrooms will produce disorder of the stomach and bowels by the effect of idiosyncrasy. In most of these cases recovery takes place, especially if vomiting be induced:—in the few instances which have proved fatal, there has been more or less inflammation in the stomach and bowels, with turgescence of the vessels of the brain. Even *Catsup*, a liquor made from mushrooms, has been known to produce serious effects. (Dub. Med. Press. Sept. 24, 1845. p. 195.)

A case is related by Christison, which shows that a medical jurist may be easily misled when any active poison is mixed with and administered in a dish of mushrooms. (779.) A servant girl poisoned her mistress, by mixing arsenic with mushrooms. This person died in twenty hours, after suffering severely from vomiting and colic pains. On dissection, the stomach and intestines were found inflamed. Death was ascribed to the effects of the mushrooms, which were considered to have been unwholesome; and the fact of poisoning only came out many years afterwards, by the confession of the prisoner. This shows with what a watchful eye such cases should be examined: in the absence of poison from the stomach, it would be extremely difficult to develope the truth.

ANALYSIS.—Most of the narcotico-irritant poisons just considered, owe their deleterious effects to the presence of an alkaloidal principle, similar to morphia, and susceptible of insulation by complex chemical processes. There is, however, considerable difficulty in extracting these alkaloids from the respective vegetables; and when extracted, the chemical differences among them, in respect to the action of tests, are so slight, as to be scarcely appreciable, even in the hands of a practised analyst. Indeed, better evidence of their nature, would commonly be derived from the exhibition of a portion of the suspected substance to animals, than from the application of chemical tests. In a medico-legal point of view, there are at present no chemical tests for these poisons, upon which reliance can be placed. When the vegetable itself has been used, either in the shape of seeds, leaves, berries, or root, then good evidence may be sometimes procured, by searching with or without the aid of a good microscope for the botanical characters of the plant; these parts of the plant may be found in the vomited matters or evacuations during life, or in the alimentary canal after death. The broken leaves are easily separable by the fact that they are quite insoluble in water: they may be therefore easily collected, dried on mica and examined by the microscope, which under the hands of a good botanist, may thus reveal the nature of the poison. This source of evidence will, however, often fail, owing to the poison having been taken,—in the form of extract, infusion or decoction, or even, in some instances, owing to the digestive action of the

stomach itself on the vegetable matter. Some years since, I was consulted in a case, in which there was hardly a medical doubt, that the life of a person had been destroyed by the decoction of a narcotico-irritant vegetable. The fact, however, could not be clearly established. It is much to be regretted, that post-mortem examinations, are not enforced as an indispensable part of the coroner's inquest, at least in all instances of narcotico-irritant poisoning. There is no department of toxicology so defective as this; only a few pathological characters have been observed in cases, derived almost exclusively from foreign authorities; and in regard to the effects of some of these poisons on the human body, nothing whatever is known except that they destroy life. The acquisition of any sort of medical experience on these points, in England, is unfortunately left to be a matter of the purest accident; and yet on a trial for murder by any of these poisons, our law-authorities would expect that a witness should be perfectly conversant with their effects on the body, while the only possible source of acquiring such knowledge in a satisfactory manner, is entirely cut off from the medical profession! Some well-informed coroners have endeavoured, in performing their duties, thus to benefit the public; but the generality of them act on the principle that the inquest in such cases, is merely to record the fact of death from an *external* view of the body.

The TREATMENT, in cases of narcotico-irritant poisoning, consists in promoting vomiting by emetics, or in drawing off the contents of the stomach by the stomach pump. If there should be reason to suppose from the seat of pain, that the poison has descended into the bowels, then laxative enemata may be used. Recoveries have taken place when the poison has been thus removed, even although formidable symptoms had set in. Cold affusion, or stimulants, may occasionally be required:—the patient, if inclined to sleep, should always be kept roused. There is no antidote to any of these poisons. The narcotico-irritants appear to have no corrosive properties:—some of them give rise to a sense of burning heat in the throat and stomach,—this is a local action entirely independent of chemical change: it is especially witnessed in the case of monkshood.

CAMPHOR.—Camphor, perhaps, belongs rather to the narcotic than the narcotico-irritant substances, so far as its action on man is concerned. I have not been able to meet with any case in which it has caused death in the human subject; but it has on several occasions produced rather alarming symptoms, and would probably have destroyed life, had it not been removed from the stomach. In the few cases that have been observed, its effects were somewhat different, though all referrible to an impression on the brain and nervous system. It will be better therefore to give an outline of these individually, rather than to group the symptoms together. The following case is reported by Mr. Hallett, of Axminster. A woman swallowed in the morning about a scruple of camphor dissolved in rectified spirits of wine mixed with tincture of myrrh. In half an hour she was suddenly seized with languor, giddiness, occasional loss of sight, delirium, numbness, tingling and coldness of the extremities, so that she could hardly walk. The pulse was

quick and respiration difficult, but she suffered no pain in any part. On the administration of an emetic, she vomited a yellowish liquid, smelling strongly of camphor. In the evening, the symptoms were much diminished, but she had slight convulsive fits during the night. The next day she was convalescent; but the dyspnœa continued more or less for several weeks. The dose does not appear to have exceeded twenty grains,—this is the smallest dose which appears to have been attended with serious symptoms.

A man, aged thirty-nine, swallowed about thirty-five grains of powdered camphor, prepared for lozenges. In twenty minutes, giddiness and dimness of sight, came on; and he fell from a chair in a kind of epileptic fit, which lasted about ten minutes. The extremities were cold, the pulse frequent and scarcely perceptible:—when roused he had scarcely power to articulate. A quantity of a clear liquid, smelling strongly of camphor, was drawn off by the stomach-pump. The man did not recover for a week, suffering chiefly from general exhaustion and suppression of urine: this latter symptom continued more or less for three months afterwards. There was no disorder of the stomach or bowels. Dr. Christison refers to a case where half a drachm of camphor given in an injection produced numbness of the scalp, and other nervous symptoms. In two other cases mentioned by him, in each of which forty grains had been taken, the symptoms were vertigo, chilliness, convulsive fits and delirium. In larger doses, symptoms of irritation make their appearance. Dr. Siemerling of Stralsund, relates that a man, aged sixty-nine, swallowed two drachms of camphor, in order to relieve some rheumatic symptoms under which he was labouring. When seen three hours afterwards, he resembled a drunken person. He complained of burning heat in the mouth, throat, and stomach,—throbbing in the head, pains in the course of the spine and a ringing in the ears,—the appearance of a dazzling light before the eyes, and these symptoms were followed by subsultus tendinum, and insensibility. In this state, he continued for an hour and a half, perspiring profusely. The man slowly recovered; but none of the camphor appears to have been ejected from the stomach. (Wildberg's Jahbuch, 1837. 3 B. 4. h.) In a case reported in the Medical Gazette, (vol. ii. 772,)—two drachms were taken by a physician, and all that he experienced was, lightness in the head and great exhilaration. There was no derangement of the stomach or bowels. He slept profoundly for some hours, and awoke very weak and exhausted. He also perspired greatly during his sleep. It is difficult to draw any conclusion from this case, as the quantity taken was conjectural; and the patient was not seen by any person, while labouring under the effects of the poison.

The largest dose of camphor that has been taken, was in a case which occurred to Wendt, of Breslau. Eight scruples were swallowed by a drunkard, dissolved in spirit. The symptoms were vertigo, dimness of sight, delirium, and burning pain in the stomach. There was *no vomiting:* the man recovered! This case shows, that camphor cannot be regarded as a very active poison.

Chemical analysis.—The camphor would probably be found in the state of lumps, or dissolved in spirit. No difficulty would occur in identifying this substance, except perhaps in a case where it had proved fatal and existed in the contents of the stomach. Its presence would be immediately known by its powerful and peculiar odour. If it were diffused in the form of lumps or powder, these might be easily separated from the contents, owing to the great insolubility of this substance. In general, it might be expected that some portions would float to the surface of water. In a doubtful case the contents of the stomach should be treated with a large quantity of alcohol:—

the alcoholic liquid filtered, and the camphor separated by adding water. It is a white solid,—possessing a well known odour.—easily dissolved by alcohol, and again separated by water,—entirely volatile without residue, and burning with a rich yellow smoky flame.

Alcohol.—The only form of poisoning by alcohol, which a medical jurist has to encounter, is that which arises from the taking of large quantities of spirituous liquors, such as gin, whisky, rum, and brandy. The two last-mentioned compounds contain about fifty-three per cent. by measure of alcohol, while gin and whisky are rather stronger, gin containing as much as fifty-seven per cent.

A large quantity of spirit has been known to destroy life suddenly, although such a case is rare. In general, the *symptoms* come on in the course of a few minutes. There are, confusion of thought, inability to stand or walk, and vertigo, followed by coma. Should the individual recover from this state, vomiting and sickness supervene. This form of poisoning presents some singular anomalies :—thus the insensibility may come on suddenly, but not immediately. Dr. Christison met with a case, where the individual fell suddenly into a deep stupor, some time after he had swallowed sixteen ounces of whisky—there were none of the usual premonitory symptoms :—in another instance, a person will apparently recover from the first effects, and then suddenly become insensible, and die convulsed. In respect to *post-mortem appearances* ;—the stomach has been found inflamed,—the mucous membrane being in one case of a bright red, and in another of a dark red brown colour. When death has taken place rapidly, there will be a strong odour of spirits in the contents of the stomach, but this may not be perceived, if some time has elapsed before the inspection is made. The brain is found congested, and, in some instances, there is effusion of blood. In a case, observed by Dr. Geoghegan, in which a pint of spirits had been taken, and proved fatal in eight hours, black extravasion was found on the mucous membrane ; but no trace of alcohol could be detected in the contents of the stomach.—(Dub. Med. Press, i. 293.)

The quantity required to destroy life, cannot be very well determined, as it depends on the age and habits of the party. A boy, aged seven, has been killed by taking two wineglassfuls of brandy. Death may take place in a few minutes, or not until after the lapse of several days. The shortest fatal case which I have found reported, was that of a man who died in half an hour after swallowing a bottle of gin for a wager. This occurred in London in 1839 : in a quarter of an hour after taking the gin he appeared intoxicated ;—he soon became insensible, and died in half an hour, although a large quantity of the spirit had been removed by the stomach pump.

The following case occurred in 1840. A boy aged seven, swallowed about three ounces of brandy :—shortly afterwards he was observed to stagger,—

he was sent to bed and vomited violently. In about four hours, he got up and sat by the fire; his head, face and neck were very red, and he was in a profuse perspiration. Half an hour afterwards he was found perfectly insensible, strongly convulsed, and the skin cold. He died in about thirty hours.

In April 1839, a case of poisoning by gin was communicated by Dr. Chowne to the Westminster Medical Society. A boy, aged eight, was found insensible about half an hour after he had swallowed the gin. The quantity taken was supposed to have been half a pint. The liquid drawn from the stomach seven hours afterwards, had no odour of gin:—nor was the odour perceptible in the breath. He was insensible and motionless, the limbs relaxed and powerless, the face pale and the surface cold. The pulse was quick, small and feeble. He died without rallying or recovering his consciousness, sixty-seven hours after taking the poison. On inspection, there were no well-marked appearances found in the body,—the brain was healthy:—there was slight effusion of serous liquid, and the veins of the pia mater were distended. The stomach was pale and free from any mark of inflammation.

The ordinary duration of fatal cases of poisoning by alcohol, is said to be from twelve to eighteen hours; but this can only be regarded as an approximative statement, since there are not many accurate reports of cases of this description, and among these there is considerable variation both as to the time of death, and the quantity of spirit taken. Of the effects of drunkenness, and of delirium tremens, nothing need here be said.

Treatment.—The contents of the stomach should be withdrawn by the pump as speedily as possible. Death may take place even where the stomach has been thoroughly evacuated, but this is the only chance of saving life.

Analysis.—The different spirituous liquids may be recognised in the contents of the stomach by their peculiar odour; but only when death has taken place very rapidly. The contents should be distilled and treated with carbonate of potash or fused chloride of calcium, and again distilled. Alcohol may be obtained in the receiver, and is known; 1, by its odour and volatility: 2, by its inflammability; 3, by its power of dissolving camphor and resins. Absorption does not appear to be absolutely necessary to the action of alcohol: but it would seem from the late researches of Dr. Percy, that he has succeeded in detecting alcohol in the brain and liver, as well as in the blood, bile and urine. A spirituous odour is said to have been perceived in the brain, in cases where death had proceeded from natural causes. It would not however be safe, when the evidence of the presence of alcohol in the body was material, for a medical jurist to rest upon any fact short of its separation by distillation.

Instances have occurred in this metropolis, where alcoholic liquids have been made the vehicles for administering other poisons, such as opium or prussic acid. Persons have been thus rendered insensible; and in this state, have been robbed or murdered. Such cases may commonly be recognized by the fact that the symptoms when known, are of far too severe a character to be referrible to the small quantity of alcoholic liquid taken. Tincture of opium is most commonly administered in this way: and in such a case, there may be some difficulty in deciding whether the symptoms of intoxication be due to the drug or to the spirit.

According to Dr. Ure, the best London porter always contains opium

as a fraudulent adulteration. He has found that, when diluted, it gives a brownish red colour with permuriate of iron, indicative of the presence of meconic acid, while tincture of hops gives only a greenish-coloured liquid. Having precipitated porter by acetate of lead, he found, on decomposing this precipitate by sulphuretted hydrogen gas, that he obtained clear evidence of the presence of meconic acid. He did not succeed in discovering morphia. (Med. Gaz. vi. 73.) These facts it may be proper for a medical jurist to bear in mind when called upon to investigate charges of administering opium in porter; but in repeating Dr. Ure's experiments, I have not obtained any results indicative of the presence of opium in this liquid. The precipitate obtained on adding a solution of acetate of lead to eight fluid ounces of porter, yielded not the slightest trace of meconic acid.

WOUNDS.

CHAPTER XXIV.

WHAT IS A WOUND? IS THE WOUND DANGEROUS TO LIFE OR DID IT PRODUCE "GRIEVOUS BODILY HARM?"

When a person is the subject of a wound or external injury, from the effects of which he ultimately recovers, a medical witness is often rigorously examined—with respect to the precise nature of the injury, and how far it involved a risk of life. The answers to these questions may have an important influence on the defence of a prisoner, when the crime is charged under particular forms of indictment.

What is a wound? It may, I think, be safely asserted, that we shall look in vain for any consistent definition of a wound, in works on medicine and surgery. A wound is, perhaps, most commonly defined to be, a "recent solution of continuity in the soft parts, suddenly occasioned by external causes." Yet those who adopt this view, do not regard as wounds, ruptures of the liver or spleen, burns by heated bodies, or simple dislocations and fractures, although all of these injuries are comprehended in the literal signification of the above definition. The following definitions of a wound have been furnished to me by three eminent surgeons of this metropolis.

"A solution of continuity from violence of any naturally continuous parts."

"An external breach of continuity directly occasioned by violence."

"An injury to an organic texture by mechanical or other violence."

Owing to the unsettled meaning of the word wound, it has happened on more than one occasion, that medical witnesses have differed in their evidence, and some difficulty has arisen in the prosecution of criminal charges. It has been asserted, that in order to constitute a wound, the skin should always be broken or injured; and this, as we shall see presently, is the interpretation commonly put upon the term by our judges. But those who have adopted this view, do not regard burns, produced either by heated metals, or corrosive liquids, as wounds; although there seems to be no good reason why, under the above definition, they should be excluded. Technical difficulties of this kind, which only lead to the embarrassment of witnesses and to the ac-

quittal of prisoners, charged with serious offences, might be avoided if the medical witnesses of England were allowed to adopt the comprehensive definition sanctioned by the legal tribunals of certain States on the Continent, namely, that "a wound includes every description of personal injury, arising from whatever cause, applied externally." It may appear contrary to propriety to designate a contusion or fracture as a wound; but the common definitions will be found on examination to be equally inconsistent, and to be attended in legal medicine by evil results, inasmuch as they lead to acquittals, not upon the merits of the case, but upon the most trivial pretences. This could not happen, if the above comprehensive signification were generally followed. It appears to me, that in a case of this kind, we should rather regard the wants of justice than the rules of surgery. If medico-legal cases fail from differences respecting the meaning of scientific terms among surgical writers, it is time that some fixed rule should be adopted. While the science of surgery cannot possibly suffer by such an innovation, the administration of the law will be rendered much more efficient.

It cannot be denied, however, that an alteration of this kind, in the use of medical terms, must, in order to be attended with any good effects, receive the support of our legal authorities. This, probably, would not be long withheld, if good reasons for the change were afforded by medical witnesses. The present rule appears to be that *no injury constitutes a wound in law, unless the continuity of the skin be broken,* so that in a case where blows were inflicted with a hammer or iron instrument sufficient to break the collar-bone, and violently bruise but not break the skin, it was held not to be a wounding within the statute. (Archibold.) A recent Act of Parliament (1 Vic. c. 85,) has in some measure provided for the punishment of persons guilty of inflicting such severe injuries, but still it has left the legal signification of the word wound, unsettled. From several recent decisions, it appears that an abrasion of the cuticle is not to be understood as a breaking of the continuity of the skin,—the cutis or true skin must participitate in the injury; and probably the cellular membrane beneath. A man was tried at the Central Criminal Court in August, 1838, on a charge of cutting and wounding the prosecutor. The prisoner struck the prosecutor a severe blow on the temple with a heavy stone-bottle, which was thereby broken to pieces. The prosecutor fell senseless, and it was a long time before he recovered from the effects of the violence. The medical witnesses in this case underwent a rigorous cross-examination by the prisoner's counsel, respecting the meaning of the word "wound." They said that there had been a separation of the cuticle or outer skin of the temple, although there was no absolute wound in the usual acceptation of the word. They further deposed that the prosecutor had lost the sight of his left eye, and the hearing of his left ear; and he was for a considerable time in a state of great danger from which he had scarcely recovered. The prisoner's counsel contended that the injuries were not

such as to constitute cutting and wounding in law. The judge said, in order that a wound, in contemplation of law, should have been inflicted, it was necessary that the *whole skin*, and not the mere *cuticle*, should have been separated and divided; and as the evidence did not show distinctly that there was such a wound, those counts of the indictment could not be sustained. The prisoner was found guilty of an assault. Had he used a penknife, although he might have inflicted a much less degree of bodily injury, this man might, according to the above doctrine, have been found guilty under the highly penal statute of wounding. (See also the case of the *Queen* v. *Mortlock*, post.)

It would likewise appear that the continuity of the skin must be broken at the time of the infliction of the violence, and as a direct effect of it. Thus, if from a severe contusion, sloughing should take place, this would not constitute a wound, notwithstanding the very extensive destruction of the skin and soft parts, as an indirect result of the violence. So if a bone of the leg be broken by a blow, and the skin lacerated and a compound fracture produced by the assaulted party falling, it is doubtful whether this would be a wounding within the statute. Again, if an assault be committed with a heated solid, such as a red-hot poker; although the whole skin might here be destroyed, it is extremely doubtful, whether such an injury would constitute a wound in law. In short, this subject, whether we regard it in a medical or legal aspect, is in a most unsettled state; and a conviction for the offence of criminal wounding, must depend in a great measure upon the care used in describing the injury in the indictment.

IS THE WOUND DANGEROUS TO LIFE, OR DID IT PRODUCE "GRIEVOUS BODILY HARM!" Answers to these questions are required of medical witnesses, on the trials of persons charged with an attempt to murder or maim. Sometimes a written medical opinion, or a deposition may be demanded of a surgeon, by a magistrate in order to justify the detention of prisoners. The law has not defined the meaning of the words "*dangerous to life*," or to what description of wounds the term *dangerous* should be applied. This is a point which is left entirely to the professional knowledge of the witness. It is not always sufficient on these occasions, that the witness should make a naked declaration of the wound being dangerous to life; he must, if called upon, state to the Court satisfactory reasons for this opinion; and these reasons are rigorously inquired into by the counsel for the defence. As a general principle, it would not be proper to consider those wounds dangerous to life, in which the danger is not *imminent*. A wound of a great blood-vessel, of any of the viscera, or a compound fracture with depression of the bones of the head, must all be regarded as bodily injuries dangerous to life; because in such cases, the danger is imminent. Unless timely assistance be rendered, these injuries will most probably prove fatal, and indeed they often destroy life in spite of the best surgical treatment. When, however, the danger is remote as in a puncture or laceration of the hand or foot which may be followed by tetanus, or in laceration of the scalp,

which may be followed by erysipelas, or in penetrating wounds of the orbit, which may be attended by fatal inflammation of the brain or its membranes, the case is somewhat different. Such injuries, as are here described, are not directly dangerous to life, they are only liable to be attended with danger in certain cases ; and therefore the medical opinion must be qualified. The law on these occasions, appears to contemplate the direct and not the future or possible occurrence of danger : if the last view were adopted, it is clear, that the most trivial lacerations and punctures might be pronounced dangerous to life : since tetanus or erysipelas proving fatal, has been an occasional consequence of very slight injuries. A difference of opinion will often exist as to whether a particular wound be or be not dangerous to life. Unanimity can only be expected, where the judgment and experience of the witnesses are equal. The rules for forming an opinion in these cases, will, perhaps, be best deduced from the results of the observations of good surgical authorities in relation to injuries of different parts of the body. These will form a subject of examination hereafter.

If the witness admit, that the wound was not dangerous to life, then he may be required to state whether it was such as to have been capable of producing "*grievous bodily harm.*" The question is sometimes put, although the common practice is to leave this to be drawn by the jury, as an inference from the professional description of the injury. These words have a vague signification ; but it would, perhaps, be difficult to substitute for them, others less open to objection. They evidently refer to a minor description of offence, and are applied commonly to those injuries which, while they are not actually dangerous to life, may be attended with considerable personal inconvenience, or be in some way detrimental to the health of the wounded party. It is always a question for a jury, whether the intent of the prisoner, in inflicting a wound, was or was not to produce grievous bodily harm ; sometimes the nature or the situation of the wound, as well as the kind of weapon used, will at once explain the intent. So far the medical witness may assist the court, by giving a plain description of the injury, as well as of the consequences with which it is usually attended. It may so happen, that the wound itself is not of a very serious nature, and yet the intention of the prisoner may have been to do grievous bodily harm to the wounded party ; a fact which must then be made out by other evidence of a non-medical kind. This, of course, has no relation to the duties of a medical witness. (*The Queen* v. *Maslin*, Devizes Summer Assizes, 1838.) The wound may be of such a nature as to cause death speedily, so that a practitioner may arrive only in time to see the wounded party die. In this case, the dying person may make a statement or declaration, as to the circumstances under which the wound was inflicted ; he may also mention the names of the parties by whom he was assaulted. This *dying declaration* or statement, according to the circumstances under which it is made, may become of material importance in the

prosecution of a party charged with homicide. It is therefore proper, that the practitioner should notice the exact condition of the dying person, whether at the time he makes the statement, he still retains any hope of recovery, either expressed in language, or implied by his conduct. It is not necessary that a man should declare that he believes himself to be dying, in order to render his statement admissible; this may be judged of by his actual bodily condition—by the symptoms under which he is labouring, and by the characters of the wound, when it is gradually but surely leading to a fatal result. No one is better qualified to form a judgment on these points than a medical practitioner. This question was argued in the Court of Exchequer, January, 1845, in the case of *Reg.* v. *Howell*, when Alderson B. said it was not necessary that the deceased should be in *articulo mortis*, or even that he should think so. It is enough if he thinks he shall die of the sickness under which he labours. (Law Times, Jan. 25, 1845, 317.) When it is made clear to the Court that all hope of life was lost, the statement will be received as evidence against an accused person; for the law supposes, hat in the act of dying, all interest in this world is taken away; and that the near contemplation of death, has the same powerful effect upon the mind, as the solemn obligation of an oath. It is presumed that there can be no disposition on the part of a dying person, to wilfully misrepresent facts, or to state what is false. Much, therefore, often depends on the conduct of a medical practitioner under such circumstances; for the usual method of testing the truth of a statement by cross-examination is, of course, out of the question: it must, if admitted at all, be received as it was made.

No statement would be admissible when taken from a person, who had still some hope of recovery; yet a case may arise in which a practitioner might be in doubt upon this point. His duty then consists in taking the statement, and leaving the Court to decide upon its admissibility from the effects observed and stated by him. A medical man should not render himself officious, in extracting information from a dying person under these circumstances. He should receive what is *voluntarily uttered;* and write the statement down, in the *identical* words, carefully avoiding his own interpretation of them, either immediately or on the earliest possible opportunity. On no account should leading questions be put;—and any question should be simply confined to the purpose of explaining what may appear ambiguous or contradictory in the declaration. It is well known that when death takes place from violence, especially when this proceeds from hæmorrhage or a wound of the head, delirium is apt to supervene, or the intellect of the dying person becomes confused. Under these circumstances, great caution should be used in receiving a declaration, since it may lead to the implication of innocent parties. It is also proper to remark, that the identity of persons is at this time apt to be mistaken; and that it is in general a most injudicious proceeding to take a suspected party before one who is dying, in order that he may be iden-

tified. A fatal mistake of this kind was made some years since in London. A woman was maltreated by some men on Kennington Common:—she was taken to St. Thomas's Hospital; and while dying from the effects of the violence, a suspected party was brought before her, as one of the supposed assailants. She deposed that he was one of those who had assaulted her. The man was tried upon her declaration, respecting his identity,—found guilty, and executed; but a year after the execution, his innocence was satisfactorily established by the discovery of the real murderers.

These are the principal medico-legal questions, connected with wounds when the wounded person is seen while living. We will suppose, however, that the wounded person is found dead, and an examination of the body is required to be made. The most difficult part of the duty of a medical jurist now commences. Among the numerous questions which here present themselves, we will first proceed to inquire whether the wound was inflicted on the body before or after death.

CHAPTER XXV.

WHETHER THE WOUND WAS INFLICTED BEFORE OR AFTER DEATH.

In examining a wound on a dead body, it is necessary to observe its situation, extent, length, breadth, depth and direction;—whether there be about it effused blood, either liquid or coagulated, and whether there be ecchymosis in the skin. It should also be ascertained, whether the surrounding parts be swollen,—adhesive matter or pus effused,—the edges of the wound gangrenous, or any foreign substances be present in it. The wound may be best examined by gently introducing into it a bougie, and carrying on the dissection around this instrument, avoiding as much as possible any interference with the external appearances. The preservation of the external form, will allow of a comparison being made at any future time, between the edges of a wound, and a weapon found on a suspected person. Of all these points, notes should be taken, either on the spot or immediately afterwards, in the way recommended in a former chapter. (See anté, p. 19.) In the dissection, every muscle, vessel, or nerve involved in the injury, should be traced and described. This will enable a witness to answer many subordinate questions that may unexpectedly arise during the inquiry. One other point should be especially attended to. A medical practitioner has frequently contented himself by confining his dissection to the injured part, thinking that on the trial of the accused party, the questions of counsel would be limited to the situation and extent of the wound only: but this is a serious mistake. If the cause

of death from a local injury, be at all obscure, on no account should the inspection be abandoned until all the organs and cavities of the body have been closely examined: since it may be affirmed that a natural cause of death might have existed in that organ and cavity, which the medical witness neglected to examine. It rests with the practitioner to disprove the probability thus urged by counsel, but he is now destitute of facts to reason from: legal ingenuity will triumph, the witness will be discomfited, and the prisoner, of whose guilt there may be, morally speaking, but little doubt, will have the benefit of his inattention, and be acquitted by the jury. An ingenious cross-examination was made in relation to an omission of this kind in the well-known case of *Greenacre*, tried in 1837 on a charge of murder by mutilation. The only part of the body of the deceased, not examined by the medical witnesses, was the spinal canal. They admitted that an injury to the spinal marrow might produce speedy death; but a blow capable of producing such injury, would be likely to leave marks of violence externally: and none existed in the region of the spine in this case. The strong corroborative evidence of the real cause of death, rendered this mode of explaining it, in the highest degree improbable. It is scarcely necessary to adduce other cases to establish the importance of the principle of duty here advocated. The simple consequence of rigorously adhering to it, will be to give a little more trouble to the practitioner, which may occasionally prove unnecessary;—while, on the other hand, the consequences of neglecting it may be to risk his professional reputation and expose him to severe reproof from the Court.

Characters of a wound inflicted during life.—If we find about the wound, marks of gangrene, the effusion of adhesive or purulent matter, or if the edges be swollen and enlarged, and cicatrization has commenced, it is not only certain that the injury must have been inflicted before death, but that the individual must have lived some time after its infliction. Marks of this description will not, however, be commonly found, when death has taken place within ten or twelve hours after the receipt of the injury. A wound which proves fatal within this period of time, will present throughout much the same characters:—supposing it to have been *incised*, there will be traces of more or less hæmorrhage, having chiefly an arterial character, and the blood coagulating as it falls on surrounding bodies:—the edges of the wound are everted, and the cellular tissue around is deeply reddened by effused blood. Coagula are found adhering to the wound, provided it has not been interfered with. The principal characters of a wound inflicted during life are then the following:—1. Eversion of the edges, owing to vital elasticity of the skin. 2. Abundant hæmorrhage, often of an arterial character, with general sanguineous infiltration of the surrounding parts. 3. The presence of coagula.

Characters of a wound made after death.—If the wound on the dead body be not made until twelve or fourteen hours have elapsed from the time of death, it cannot be easily mistaken for one produced

during life. Either no blood is effused, or it is of a venous character, proceeding from some divided vein—the blood is commonly liquid, not coagulating as it falls on surrounding bodies, like that poured out of a vital wound. The edges are soft, yielding and destitute of elasticity, they are therefore in close approximation. The cellular tissue around, is either not infiltrated with blood, or only to a very partial extent. There are no coagula within the wound. In experimenting upon amputated limbs, I have found these same characters possessed by a post-mortem wound, even where it had been produced not later than two or three hours after death: although they are best seen when the wound is not made until after the body has lost all its animal heat. In wounds on the dead subject, divided arteries have no marks of blood about them: in the living subject the fatal hæmorrhage commonly proceeds from these vessels: hence, in a wound on the living, it will be found that the surrounding vessels are empty. The chief characters of a post-mortem wound, are therefore,—1. Absence of copious hæmorrhage. 2. If there be hæmorrhage, it is exclusively venous. 3. The edges of the wound are close, not everted. 4. There is no sanguineous filtration in the cellular tissue. 5. There is an absence of coagula. But it may happen, that a wound was inflicted soon after the breath had left the body, and while it was yet warm. The distinction between a wound then made, and one made during life, is not so well marked, as in wounds inflicted at a later period after death. Observations of this kind, on the human subject, must of course be purely accidental, and there are many obstacles to the performance of experiments on the recently dead. I, therefore, selected limbs, immediately after amputation; and there is no reason to suppose, that the results obtained in these cases, would differ very widely from those derived from experiments made on the entire body.

In the first experiment an incised wound about three inches in length was made in the upper part of the calf of the leg *two minutes* after its separation from the body, by which the gastrocnemii muscles and the fascia covering the deep-seated layer of the leg, were divided. At the moment that the wound was made, the skin retracted considerably, causing a protrusion of the adipose substance beneath: the quantity of blood which escaped was small, the cellular membrane by its sudden protrusion forwards, seeming mechanically to prevent its exit. The wound was examined after the lapse of twenty-four hours,—the edges were red, bloody and everted,—the skin was not in the least degree tumefied but merely somewhat flaccid. On separating the edges, a small quantity of fluid blood escaped, but no coagula were seen adhering to the muscles. At the bottom of the wound, however, and in close contact with the fascia, was a small quantity of coagulated blood; but the coagula were so loose, as readily to break down under the finger. In the second experiment, an incision of similar extent was made on the outer side of the leg, penetrating through the peronei and into the flexor longus pollicis of the deep-seated layer of muscles, *ten minutes* after the separation of the member from the body. In this case, the skin appeared already to have lost its elasticity, for the edges of the wound became but very slightly everted; scarcely any blood escaped from it. On examining the leg twenty-four hours afterwards, the edges of the incision were pale and perfectly collapsed, presenting none of the characters of a wound inflicted during life. Still, at the bottom of the wound, and enclosed by the divided muscular fibres, there were some

coagula of blood, but these were certainly fewer than in the former experiment. A portion of liquid blood had evidently escaped owing to the leg having been moved. Other experiments were performed at a still later period after the removal of the limbs; and it was found that in proportion to the length of time suffered to elapse before the production of the wound, so were the appearances less distinctly marked, that is to say, the less likely were they to be confounded with similar injuries inflicted upon the living body. When the incised wound was not made until *two or three hours* after the removal of the limb, although a small quantity of liquid blood was effused, no coagula were found.

It is necessary to remember that when an incised wound is the cause of death, the person either dies immediately, in which case there is a most abundant hæmorrhage from the wounded organ or some large vessel,—or he dies after some time, in which case, as the wound continues to bleed during the time that he survives, the longer he lives the more copious will be the effusion of blood. In a wound inflicted soon after death, and while the body is warm, nothing of this kind is observed. Unless the weapon injure one of the large veins, the hæmorrhage is always slight, so that the quantity of blood lost, may assist us in determining whether the wound was made during life or after death. When the body has been moved, and all marks of blood effaced by washing, rules of this kind cannot serve a medical witness: —the time at which the wound was actually inflicted, must then be deduced from other circumstances.

In the case of *Greenacre*, who was tried in 1837, for the murder and mutilation of a female, this formed a material part of the medical evidence. The head of the deceased had been severed from the body, and the question was, whether this severance had taken place during life or after death. The prisoner alleged in his defence, that it was after death; but the medical evidence went to establish that the head must have been cut off, while the woman was living, but probably after she had been rendered insensible by a blow on that part, the marks of which were plainly visible. This medical opinion was founded on two circumstances. The muscles of the neck were retracted, and the head was completely drained of its blood, showing that a most copious and abundant flow must have ensued at the time of the separation; and therefore indicating that the circulation was probably going on at that time. On cutting off a head after death, a small quantity of blood may escape from the jugular veins; but this soon ceases, and the quantity lost, is insufficient to affect materially the contents of the cerebral vessels. The chief medical witness, Mr. Girdwood, expressed himself with very proper caution, by stating, in answer to a question from the judge, that all the wounds in the neck must have been inflicted either *during life or very shortly after death*, while the body still preserved its warmth. The circumstantial evidence tended to show, that the deceased was first stunned, and that her head was cut off while she was in a state of stupor.

In any future case, when the vital or post-mortem origin of a wound is doubtful, it will be proper to adopt the same cautious mode of expressing a medical opinion; since there are no decisive characters by which wounds of the kind referred to, can be distinguished; and a medical witness is as likely to be wrong as right in selecting either hypothesis. It is a considerable step in evidence, when we are able to assert, that a particular wound found on a dead body, must have been inflicted either during life or *immediately* after death; for it can

scarcely be supposed, that in any case, calling for criminal investigation, any one but a murderer would think of inflicting such a wound upon a body immediately after death, which would assuredly have produced fatal effects had the same person received it while living. So soon as such an opinion can be safely expressed by a witness, circumstantial evidence will often make up for that which may be medically speaking a matter of uncertainty.

Wounds or injuries unattended by hæmorrhage.—The copious effusion of blood has been set down as a well-marked character of a severe wound received during life; but this observation applies chiefly to incised wounds,—cuts and stabs. Lacerated and contused wounds of a very severe kind, are not often accompanied by much hæmorrhage, even when a large blood-vessel happens to be implicated. It is well known, that a whole member has been torn from the trunk, and that little blood has been lost; but in such cases, coagula are commonly found adhering to the separated parts,—a character which indicates either a vital or a very recent post-mortem origin. Contusions and contused wounds are commonly accompanied by a discolouration of the surrounding skin, to which the term ecchymosis is applied.

Ecchymosis.—The subject of ecchymosis is of considerable importance in legal medicine, since it has often given rise to numerous difficulties and complicated questions. It consists essentially in the extravasation or effusion of blood from ruptured vessels into the surrounding cellular texture. An ecchymosis is in general superficial, affecting only the layers of the skin and showing itself externally, either immediately or in the course of a short time, in the form of a deep blue or livid red patch. According to Dr. Chowne, the former colour is met with in the ecchymosis slowly produced; while that which is the immediate result of violence, is red or livid red. In some instances, the ecchymosis is deep-seated,—the blood being effused among the muscles and beneath the fasciæ; its extent cannot then be so readily determined by the external discolouration, for this is commonly slight, and it appears only after the lapse of some hours, or even two or three days. Sometimes the ecchymosis shows itself not over the immediate seat of injury or around it, but at some distance from it. This is a matter of some importance to the medical jurist, since he might be led to suppose that the violence had been applied to the discoloured portion of skin, whereas the extravasation may have been produced by what some have called contre-coup. Dr. Chowne met with an instance where a young man received a severe bruise on the inner side of the ankle. In two days, ecchymosis appeared around the outer ankle. The term contre-coup is, however, inappropriate; since the blood will diffuse itself where it meets with the least resistance, and the layers of the skin in the part struck may become condensed by the blow, so that the blood is diffused in the cellular membrane of the adjoining parts. Mr. Syme, of Edinburgh,

met with a case where a compound fracture of the tibia, about one-third down, was produced by the wheel of a carriage passing over the leg of a woman. There was no ecchymosis around the seat of injury; but after some days, the skin of the knee and lower part of the thigh became ecchymosed. (Ed. Med. and Surg. Jour. Oct. 1836.) It is proper to mention, that ecchymosis may sometimes proceed from causes irrespective of the direct application of violence to the skin. Strong muscular exertion,—the act of vomiting, and many other conditions, may give rise to a rupture of the minute vessels, and to an effusion of blood in parts which have been stretched or compressed. I have known it to have been produced to a great extent around the knee, from the stretching of the ligamentum patellæ, in an individual, who was trying to save himself from suddenly falling forwards with his knee bent under him. Such cases are commonly recognised by there being no mark of mechanical injury about the part:—the skin is smooth and unabraded.

The changes which sometimes take place in the colour of an ecchymosed spot, are worthy of the attention of a medical jurist, since they will serve to aid him in giving an opinion as to the probable time at which a contusion has been inflicted. After a certain period, commonly in eighteen or twenty-four hours, the blue or livid margin of the spot is observed to become lighter; it acquires a violet tint, and before its final disappearance, it passes successively through shades of a green, yellow and lemon colour. During this time, the spot becomes much increased in extent, but the central portion of the ecchymosis is always darker than the circumference. These changes have been referred by Chaussier and others to the gradual dilution of the extravasated blood by the serous fluid of the cellular membrane, and its slow and uniform dispersion throughout the cells. The colour is finally entirely removed by the absorption of the extravasated blood. The extent and situation of the ecchymosis, the degree of violence by which it has been produced, as well as the age and state of health of the person, are so many circumstances which may influence the progress of these phenomena. Thus an ecchymosis is longer in disappearing in the old than in the young. Mr. Watson, of Edinburgh, found extravasated blood in an ecchymosis in an old person, five weeks after the receipt of the injury. Where the cellular membrane is dense, the ecchymosis, cæteris paribus, is not so rapidly formed; nor, when formed, do the above changes take place in it, so speedily as where the blood is effused into a loose portion of the membrane, like that surrounding the eye or existing in the scrotum. In some instances an ecchymosis has been observed to disappear without undergoing these changes of colour at its margin. On examining an ecchymosed portion of skin which has suffered from a severe contusion, we find that the discolouration affects more or less the whole substance of the cutis as well as the cellular membrane beneath: this, it is necessary to remember in forming our diagnosis.

It not unfrequently happens that the ecchymosis produced by a con-

tusion, will assume a form indicative of the means by which the violence was offered. In hanging, the impression caused by the cord on the neck, is sometimes ecchymosed and indicates its course with precision;—so also in strangulation, when the fingers have been violently applied to the fore part of the neck, the indentations produced may serve to point out the manner in which life was destroyed. A case is mentioned by Starkie, which shows that the form of an ecchymosis may occasionally furnish very strong presumptive evidence against an accused party. In an attempt at murder, the prosecutor, in his own defence, struck the assassin violently in the face with the key of the house-door, this being the only weapon he had near at hand. The ecchymosis which followed this contusion, corresponded in the impression produced on the face, to the wards of the key; and it was chiefly through this very singular and unexpected source of evidence, that the assassin was afterwards identified and brought to trial. (Law of Evidence, vol. i. Art. Circ. Ev.) For our knowledge of the effects of *contusions* on the recently *dead* subject, we are chiefly indebted to Dr. Christison. This gentleman found that blows inflicted two hours after death, will give rise to appearances on the skin similar to those resulting from blows inflicted recently before death. The livid discolouration thus produced, generally arose from an effusion of the thinnest possible layer of the fluid part of the blood on the outer surface of the true skin, but sometimes also from an effusion of blood into a perceptible stratum of the true skin itself. He likewise found that dark fluid blood might even be effused into the subcutaneous cellular tissue in the seat of the discolourations, so as to blacken or redden the membranous partitions of the adipose cells, but this last effusion was never extensive. From this, then, it follows, that by trusting to external appearance only, contusions made after death, may be easily confounded with those which have been produced by violence immediately before death.

If the contusion has been caused some time before death, there will be swelling of the part and probably also certain changes of colour in the ecchymosed patch, in either of which cases there will commonly be no difficulty in forming a diagnosis. Although ecchymosis or an appearance analogous to it may be produced after death, the changes in colour are only then met with under very peculiar circumstances, to be presently mentioned. If the blood found beneath the ecchymosed spot is in the state of coagulum, this affords a remote presumption of its having been effused during life, although, in fact, it only proves that the effusion must have taken place before death, or very soon after it; and the experiments related, in speaking of incised wounds, show that the blood effused from a wound ten minutes after death, may be found in a coagulated state. Again, the circumstance of the blood effused under a contused wound being liquid, is not to be considered as a proof that the effusion did not take place during life; for sometimes the effused blood will not coagulate after death. Blood effused into the spinal canal during life is often fluid: and it is well known that the

blood may be found coagulated in some parts of the body, while it remains uncoagulated in others. Those contusions, produced during life, in which the effused blood remains liquid, may be recognised by the extent of the effusion. If, under the ecchymosed part, we find a large quantity of liquid blood and the seat of injury is so situated that the blood could not have become infiltrated into it, and at the same time there is no ruptured vein from which it might have flowed, we may confidently pronounce that the effusion must have preceded death. In a dead body, a contusion would cause but little extravasation, unless a vein of very apparent size were torn through. The sign which is most satisfactory as a criterion, in the opinion of Dr. Christison, is the following. In a contusion inflicted during life, the ecchymosed portion of cutis is generally dark and much discoloured by the infiltration of blood throughout its whole thickness,—the skin at the same time is increased in firmness and tenacity. This is not, however, a uniform consequence of a contusion during life; for a blow may cause extensive extravasation below the skin without affecting the cutis in the manner stated. The state of the skin here described, cannot, however, be produced by a contusion on a dead subject; but it is questionable whether it might not be produced if the contusion were inflicted a few minutes after death. As it is, its value is somewhat circumscribed,—it is not always produced on the living,—it might be possibly produced on the recently dead, so that when it does not exist, we must look for other diagnostic marks, and when it does exist, we ought to satisfy ourselves that the contusion was not inflicted recently after death.

The period at which such injuries cease to resemble each other, has not been fixed with any degree of precision; but, as in the case of incised wounds, it would seem that there is little danger of confounding them when the contusion has not been inflicted on the dead subject, until after the disappearance of animal heat and the commencement of cadaverous rigidity. Dr. Christison remarks, that sometimes the appearance of contusions can hardly be produced on the dead body two hours after death, at others they may be slightly caused after three hours and a quarter, but this period is near the extreme limit. Whenever the warmth of the body and the laxity of the muscles are not considerable at the time the blow is inflicted, the appearance of vital contusions cannot be very clearly produced. It is probably, therefore, only on the trunk that, even in the most favourable state of the body, namely, when the blood remains altogether liquid, any material mark resembling what may be termed a vital contusion, can be produced so late as *two hours* after death. (Ed. Med. and S. Journ. No. xcix. p. 247 et seq.) Notwithstanding these very satisfactory results, it will be seen, that from the moment of death until after the lapse of two hours, contusions may be followed by appearances on the dead body almost identical with those observed on the living. The earliest period after death in which an experiment was tried on the human subject, was one hour and three-quarters; in this case the simi-

larity was so strong that we may infer, if the experiments had been performed within half an hour, or even one hour after dissolution, a clear diagnosis would have been scarcely possible.

There are certain conditions of the body in which ecchymosed marks are found on the skin, and which a witness must be careful not to confound with the ecchymosis arising from violence. First, with regard to the *living* body—in very aged persons, it is not unusual to find the legs and feet covered with livid patches, sometimes of considerable uniformity of colour, at others very much mottled. These discolourations, which, after death, might be mistaken for ecchymosis from violence, are owing to the languor of the capillary circulation in such subjects: the blood with difficulty finds its way through the venous capillaries, and the marks are commonly observed on this part of the body, because it is far removed from the centre of circulation, and the blood has to rise contrary to the law of gravity. This is the condition which has been denominated by Andral, asthenic hyperemia. (Andral Anat. Pathol. t. i. p. 40.) Similar discolourations are sometimes met with on the bodies of those who have died from scurvy, typhus and other adynamic diseases. In persons severely affected with scurvy, it is well known that the slightest pressure on any part of the skin will suffice to produce a spot resembling ecchymosis, and arising like it from a rupture of minute cutaneous vessels; but the extravasation of blood, which causes the discolouration, is commonly confined to the superficial layers of the true skin. These spots under certain states of the system, occur spontaneously, and often cover the body to a great extent; when small, they take the name of petechiæ, but when extensive, in which case they bear a very close resemblance to the ecchymosis of violence, they constitute the chief pathognomonic character of the disease termed purpura. To all these effusions of blood in the living body the term *Sugillation* (from *sugillatio*—a black mark) has been applied. Some medical jurists have attempted to draw a distinction between ecchymosis and sugillation,—thus it is said;—ecchymosis proceeds from external, sugillation from internal causes,—ecchymosis is confined to the marks which occur in the living body, sugillation to those which occur in the dead,—in ecchymosis the vessels are ruptured, in sugillation there is mere congestion;—again, some have considered that ecchymosis and sugillation might take place both in the living and in the dead. From this statement, it appears impossible to give a consistent definition of the meaning of either of these terms; but it is altogether unnecessary to make the attempt, for the error, after all, consists in the introduction of a superfluity of words to express a simple condition of the body, depending on different causes. Why, according to the view taken by Chaussier, an ecchymosis should not also be called a sugillation, it is difficult to say; for so far as we are bound by a comparison of the definitions above given, with the usual applications of these words, the terms are equally appropriate. I would advise a medical jurist to avoid the use

of the term sugillation, if by employing it, he considers that he is speaking of a condition essentially different from ecchymosis. The most important point to attend to, is to distinguish these ecchymoses in the living body arising from infirmity or disease, from those which have their origin in violence. In regard to the spots on the legs of old persons, the appearance of the subject, and their general extent, enveloping, as they often do, the whole circumference of the leg, must suffice to establish a correct diagnosis. In distinguishing the spots of purpura a difficulty may sometimes exist,—but here also the appearance of the subject, the general diffusion of the spots over the whole of the body, and their existence on the mucous membrane of the fauces and alimentary canal, cannot fail to point out that they originate from some other cause than violence. In the living, these spots have been observed to undergo the same changes of colour, as the true ecchymosis of violence. It has been alleged on the authority of Zacchias, one of the early writers on Medical Jurisprudence, that a diagnosis is obtained in these cases after death, by a dissection of the part. According to this authority, in what is termed sugillation, i. e. the ecchymosis of disease, the blood is stated to be fluid, while in the ecchymosis of violence, it is described as being in a thick and concrete state. In the remarks already made respecting contusions, facts have been mentioned which show that such a mode of distinction is inadmissible; neither the state of the blood nor its situation will alone suffice to determine the question. Although it has been usual to describe the ecchymosis of disease as being due to a superficial extravasation on the true skin, yet certain cases recorded by pathologists, prove that in purpura, the discolouration may occasionally extend through the whole substance of the integuments to the adipose tissue beneath.

Secondly, With regard to the *dead* body. Ecchymosis may present itself in various forms on the skin of a dead subject. The first form, when it occurs, is almost an immediate consequence of death, but it is not fully developed until the body has cooled. It is commonly called *lividity* or cadaverous ecchymosis. It presents itself in diffused patches of very great extent, sometimes covering the whole of the fore part of the chest and abdomen, at other times the lateral regions of the back. The upper or lower extremities either on their internal or external surfaces, or on their whole circumference, are often thus completely ecchymosed. The colour is sometimes purple, at others livid, and often mottled in interspaces, but it is commonly well defined in its extent by the whiteness of the surrounding skin. This form of ecchymosis is almost invariably seen on the bodies of those who die suddenly or by a violent death, as in individuals who perish from apoplexy or who are hanged or suffocated. When the skin is divided, the colour is found to be confined to the upper surface of the cutis, and never to extend through it. This discolouration is ascribed to the congestion which takes place in the capillary system at the moment of death in subjects which are full of blood. It is rarely seen in the

bodies of those who have died from profuse hæmorrhage—the skin is in these cases commonly pallid. The circumstances under which it occurs, and the characters above described, distinguish it from the ecchymosis of violence. Its existence on the dead body, must be regarded as a sign of the vigour and activity of the circulation at the moment of death, and generally as a mark of death having taken place suddenly. It might seem improper to call this, which has been described as a mere capillary congestion—'*ecchymosis*'—this word signifying effusion; but the term *sugillation* has been so vaguely employed by different writers, that I think the former preferable to the latter, in spite of the apparent inconsistency of its application to every variety of cutaneous discolouration. (See Henke Zeitschrift der S. A., 1844, i. 199.)

Sometimes, instead of seeing this cadaverous lividity diffused in large patches over the skin, it will be disposed in stripes which traverse and intersect each other in all directions, and often cover the whole of the body. These marks, which vary from a scarlet to a dark red or livid hue, have been supposed to resemble those produced on the skin in the act of scourging or flagellation. On this account they have been called by some writers *vibices*. Sometimes the body is completely covered with them,—they are often of considerable length, and pass in a very symmetrical but occasionally tortuous course; they are chiefly observed about the sides, the upper part of the shoulders, and back. In meeting with this appearance for the first time on a subject, an individual, unacquainted with its nature, might look upon it as a strong proof of violent treatment during life, especially in a case of suspected violence; but the practitioner will distinguish it readily, by the uninjured state of the cuticle and the superficial nature of the discolouration, from those marks of violence which it is considered to resemble. In general it appears to be produced by the wrapping of a body in a sheet or other covering soon after death, and allowing it to cool while thus wrapped up: even if a subject be allowed to cool merely with the clothes covering it, these peculiar marks will often be seen. In many cases they exist only on the back, and here they are to be ascribed to the pressure produced by the irregularities or folds in the sheet on which the body has been lying. The blood, it is to be observed, is always congested in or near those parts of the skin which are exposed to the least pressure. A few years since I saw a well-marked case of vibices, in which the suspicion was so strong that violence had been used to the deceased, that a coroner's inquest took place. The fore part of the body was covered with the stripes, which were of a red and livid colour: they seemed to correspond exactly to the folds of a sheet drawn tightly across the chest, and I subsequently ascertained that the body of the deceased had been treated in this way after death. The blood was superficially diffused, and the cuticle sound. The circumstance above mentioned, at once satisfactorily explained the cause of the appearance. These vibices, like the cadaverous ecchymosis already described, are commonly seen in plethoric

subjects; they also indicate great vigour of circulation at the moment of death.

But lividity sometimes presents itself in a more deceptive form than in either of the instances just mentioned, as in the following case. A man, aged thirty-three, died suddenly from disease of the heart. Eighteen hours after death, the body was examined, and the skin was then found to be covered in different parts with patches of ecchymosis, varying in size from small spots to others of several inches in diameter. These patches were evidently due to simple lividity, although they closely simulated marks of violence produced during life. On cutting into them, the layers of the cutis as well as the cellular tissue beneath, were throughout reddened by congested blood. There was no decided extravasation, but small rounded semicoagulated masses oozed out from the cells on slight pressure. There was another extraordinary, and so far as I know, a perfectly unexampled circumstance, in which these patches of lividity resembled the ecchymosis of violence, produced during life. Around many of them, there was a wide border or ring of straw colour with various shades of green, precisely similar to those witnessed in the disappearance of an ecchymosis from the living subject. By all medical jurists, it has been hitherto laid down as a positive rule, that these rings of colour, when not depending on putrefaction, are peculiar to the ecchymosis of the living body, and are never seen in the ecchymosis taking place spontaneously after death. The occurrence of this case, shows with what caution general rules should be framed for medico-legal practice. The formation of the coloured zones around some of the patches of lividity, was fully explained by the fact of the man having laboured under anasarca. The serum effused in the cells here acted upon and diluted the blood as it became extravasated, and diffused it around, much in the same way, as the serous exhalation of the cellular membrane acts on the blood effused in the living body. A wax model of this remarkable appearance, is preserved in the Museum of Guy's Hospital, and is well worthy of inspection.

Another form of ecchymosis observed in the dead body, is that which occurs some time after death. This appears to proceed from an infiltration of blood into the depending parts of the body and to be a result of incipient *putrefaction*. Those engaged in post-mortem inspections, are well aware that the skin of the back, especially that covering the loins and buttocks, often presents irregular discolourations resembling ecchymosis. The skin of the occiput, is a well-known seat of this form of ecchymosis. On cutting into the skin of any of these parts, the whole of the cutis, is found to be more or less discoloured, and the adipose tissue is filled with a sanguineous serum which readily escapes. In proportion as putrefaction advances, the discolouration becomes greater, passing from a dark red to a green colour. The general characters of this species of ecchymosis, are so well marked, that it cannot easily be confounded with the ecchymosis of violence. The parts of the body in which it is known to occur, as well as the

state of the body are circumstances which distinguish it from all the other forms described. This variety of ecchymosis is also termed sugillation by some medical jurists. On the subject of Ecchymosis, see Ann. D'Hyg. 1843. ii. 388.

IS ECCHYMOSIS A NECESSARY AND CONSTANT RESULT OF ANY VIOLENCE PRODUCING CONTUSION?—This is a most important medico-legal question, and one which has often created great difficulty to medical witnesses. It has been repeatedly asserted in Courts of law, that no severe blow could have been inflicted on a deceased person in consequence of the absence of ecchymosis from the part struck; but we shall see, that this assertion is entirely opposed to well-ascertained facts. However true the general principle may be, that severe contusions are commonly followed by ecchymosis, it is open to numerous exceptions; and unless these be known to the practitioner, his evidence may mislead the Court. The presence of ecchymosis, is commonly presumptive evidence of the infliction of violence; but its absence does not negative this presumption.

It was long since remarked by Portal, that the spleen had been found ruptured from blows or falls, without any ecchymosis or abrasion of the skin, appearing in the region struck. The same has been more recently remarked in respect to ruptures of the stomach, intestines and urinary bladder, from violence directly applied to the abdomen. Portal supposed that the mechanical impulse was simply transferred through the supple parietes of the abdominal cavity to the viscera behind, as in the striking of a bladder filled with water. Whether this be the true explanation or not, it is quite certain that the small vessels of the skin often escape rupture from the shock, so that their contents are not extravasated. A case is reported by Henke, from which it appears, that a labouring man died some hours after fighting with another. On inspection, the peritoneum was extensively inflamed owing to an extravasation of the contents of the jejunum, which was found ruptured to a considerable extent. There was no ecchymosis or mark on the skin externally, and the medical inspectors were inclined to affirm, contrary in this case to direct evidence, that no blow could have been struck; but others were appealed to, who at once admitted that the laceration of the intestine, might have been caused by a blow, even although there was no appearance of violence externally. Mr. Watson states, that a girl aged nine, received a smart blow upon the abdomen from a stone. She immediately complained of great pain; collapse ensued, and she died in twenty-one hours. On inspection there was no mark of injury externally. The ileum was found ruptured, its contents extravasated; and the peritoneum extensively inflamed. (On Homicide, 187.) Dr. Williamson, of Leith, met with a case where a man received a kick on the abdomen from a horse. He died in thirty hours from peritonitis. The ileum was found to have been completely torn across in its lower third. There was not the

slightest trace of ecchymosis externally, and this fact is the more remarkable, since the blow was here struck by a somewhat angular or pointed body—the hoof of a horse. (Med. Gaz. May, 1840.) A girl was accidentally struck on the back by a log of timber, and she died in a few minutes afterwards. On inspection the right lobe of the liver was found torn through, and the stomach greatly lacerated. Notwithstanding the production of these severe injuries, there was no trace of ecchymosis, or any other mark of violence externally. (Henke Zeitschrift der S. A. 1837, ii. 356.)

The same facts have been observed in injuries of the chest, where, from the bony nature of the parietes, we might commonly expect to find ecchymosis or abrasion to some extent. Dr. Geoghegan, of Dublin, has described a case, where a girl was struck by the seat of a jaunting car, the wheel of which was supposed to have passed over her. She was killed on the spot. The chest was carefully examined,—the skin, muscles, and thoracic parietes afforded no indications of violence; but it was found that there was considerable effusion of blood, and the heart was ruptured throughout its entire length. (Dub. Med. Press, ii. 271.) In an accident, which occurred in October, 1841, a girl was run over by a cab :—she died in two hours. There was no ecchymosis, or mark of injury externally; but the right lung was ruptured, and blood was extravasated in the chest. In March, 1840, a man was brought into St. Thomas's Hospital who had been run over by a waggon. He survived thirty-six hours. On examination all the ribs on the right side of the chest were found broken. The right pleura was filled with blood and the lung collapsed. Part of the right kidney was lying amidst the blood, having passed through a fissure produced in the fleshy part of the diaphragm by one of the broken ribs. In this case of very severe injury, there was no external mark of bruise or ecchymosis :—the skin was uninjured. For another remarkable case by Mr. Pyper, see Lancet, Oct. 26, 1844. p. 127 ; and July 20, 1844. p. 531.

That the skin is not always injured in these severe cases of violence, appears to be due to its great elasticity ; but it is difficult to explain, how the vessels should escape being ruptured by a crushing force, where there is a bone beneath ; nevertheless such is the fact, and it is with the fact more than with the explanation, that a medical jurist has to deal. It has been supposed necessary, that an individual should survive the effects of violence for some hours, in order that ecchymosis should be observed in the part struck. Ecchymosis is certainly not always an immediate result of a bruise :—it may not appear for six or eight hours, or until after the second day, and in an instance mentioned by Dr. Chowne, where a young woman received a severe blow under the right breast, there was no discolouration of the skin until after the fourth day. In one case of severe injury just related, the individual did not die until after the lapse of thirty-six hours : but there was no ecchymosis. Many cases of the non-production of ecchymosis by violence may be probably referred to the fact, that death takes place

rapidly, and before there is time for the effusion of much blood from the minute vessels : but this explanation cannot apply in all cases ;—for ecchymosis is often an *immediate* consequence of a severe blow,—it has even been produced by blows on the recently dead body, and therefore it would seem that the continuance of active life was not indispensable to its production. (antè, p. 292.)

Many more cases might be adduced in support of the proposition, that ecchymosis is not a necessary or constant result of a severe contusion ; but those already related, sufficiently establish the fact. This medico-legal question was raised on a trial before the Justiciary Court of Glasgow, in January, 1837. A woman was found dead in her house, and her husband was accused of having murdered her. There was no mark of violence externally ; but on opening the abdomen, the liver was found extensively lacerated, and there was no doubt that this was the cause of death. A medical witness asserted, that as there was no appearance of injury externally, the rupture could not have been caused by a fall or a blow. He attributed the absence of marks of ecchymosis to the rupture having been occasioned by the forcible pressure of some heavy rounded smooth body on the abdomen. The prisoner was acquitted on a verdict of not proven. The liver is seldom ruptured except from violence directly applied, and it is observed that the rupture is more commonly caused by the sudden, than by the slow application of violence. The explanation given by the witness, would neither account for the rupture nor for the absence of ecchymosis ; for these conditions are more commonly met with under directly opposite circumstances. At the same time in cases where the facts are imperfectly known, a surgeon must not be too ready to assume, in the absence of ecchymosis or abrasion, that violence has been directly applied and caused the rupture of an internal organ. The liver may have been ruptured in the above case either by a blow or a fall,—the absence of ecchymosis in the parietes, is not incompatible with either view.

At the Perth Circuit Court, April, 1836, a woman named *Finlay*, was indicted for the manslaughter of her husband. The medical evidence established that the deceased, during a quarrel with his wife, had met with a severe compound fracture of the leg, but there was no ecchymosis whatever on any part of the limb. Five medical witnesses deposed, that, in their opinion, the fracture must have been produced by a blow, and not by an accidental fall. In cross-examination, they were required to reconcile this opinion with the entire absence of ecchymosis. One witness said, that a blow sufficient to cause simple fracture would cause ecchymosis,—a second that ecchymosis seldom occurred until some hours after such an accident : this explanation, however, was set aside by the fact that the man lived several days, and no ecchymosis appeared. Mr Syme said, that in an open wound, when the blood was allowed to flow away, there would be no ecchymosis. The others thought that ecchymosis ought to be produced by blows inflicted on any part of the body, and judging from external appearances, they should have supposed that no blows could have been inflicted on the deceased. Mr. Lizars appeared in favour of the prisoner ;—he is reported to have said that the fracture had resulted from a fall, and not from a blow. Had it resulted from a blow, he should have expected to find ecchymosis, tumefaction and ruffling of the

skin in the vicinity. Such violence as would have produced the fracture, must (?) have caused these appearances. The jury found the prisoner guilty of a minor offence. (Ed. M. & S. J. Oct. 1836.) In this case, the explanation given by Mr. Syme sufficiently accounted for the non-occurrence of ecchymosis. The absence of this state of the skin could not, however, be said to furnish any evidence of the mode in which the fracture originated. Ecchymosis, if produced at all, may be caused either by a fall or a blow; and as it was admitted, that any force, adequate to produce the fracture, might have caused this appearance, it is impossible to assent to the proposition, that the absence of ecchymosis, was any proof that the fracture had been caused by a fall.

CHAPTER XXVI.

BY WHAT MEANS WAS THE WOUND INFLICTED? IF BY A WEAPON, WHAT KIND OF WEAPON?

It sometimes happens on criminal investigations, that a weapon is presented to a medical witness; and he is required to say, whether a wound, found on the body of a person, was produced by it. On the certainty of a weapon having been used, it is not uncommon for prisoners, even when found guilty upon the clearest evidence, to declare that no weapon was employed by them, but that the wound had been occasioned by accidental circumstances. A witness should remember, that he is seldom in a position to swear that a particular weapon produced at a trial, must have been used by the prisoner:—he is only justified in saying, that the wound was caused either by it, or by one similar to it. In reference to this subject, Schwörer relates the following case. A man was stabbed by another in the face, and a knife with the blade entire, was brought forward as circumstantial evidence against him,—the surgeon having declared that the wound must have been caused by this knife. The wounded person recovered, but a year afterwards a fistula formed in the face, and the broken point of the real weapon was discharged from the sinus. The wound could not therefore have been produced by the knife which was brought forward as evidence against the prisoner at the trial. (Lehre von dem Kindermorde.) Although the criminality of the act is not lessened or impugned by an occurrence of this kind, it is advisable that such mistakes should be avoided by the use of proper caution on the part of a witness. On this question see the case of *Reanud* by Dr. Boys de Loury. Ann. D'Hyg., 1839, xi. 170. As to what is a weapon, see Henke Zeitschrift der S. A., 1844, i. 67.

Let us now suppose, that no weapon is discovered; and that the opinion of a witness is to be founded only on an examination of the wound. It is right for him to know that on all criminal trials considerable importance is attached by the law to the fact of a wound having been caused by the use of a weapon; since this often implies malice, and in all cases a greater desire to injure the party assailed,

than the mere employment of manual force. Some wounds at once indicate that they must have been produced by weapons. This is the case with cuts or stabs. In *Incised* wounds, the sharpness of the instrument may be inferred by the cleanness and regularity with which the edges are cut:—in stabs also, the form and depth of the wound, will often indicate the kind of weapon employed. *Stabs* sometimes have the characters of incised punctures, one or both extremities of the wound being cleanly cut, according to whether the weapon was single or double-edged. Dupuytren has remarked, that such stabs, owing to the elasticity of the skin, are apparently smaller than the weapon, a point to be remembered in instituting a comparison between the size of the wound and the instrument. When a stab has traversed the body, the entrance-aperture is commonly larger than the aperture of exit; and its edges, contrary to what might be supposed, are sometimes everted owing to the rapid withdrawal of the instrument. That facts of this kind should be available as evidence, it is necessary that the body should be seen soon after the receipt of a wound, and before there has been any interference with it.

It is important to notice, whether the edges of a *Punctured* wound be lacerated and irregular or incised; because it may be alleged in the defence, that the wound was produced by a fall on some substance capable of producing an injury somewhat resembling it. In a case that occurred to Mr. Watson, a deeply penetrating wound on the genital organs of the deceased, which had evidently caused her death, was ascribed by the prisoners charged with the murder, to her having fallen on some broken glass; but it was proved that the edges of the wound were bounded everywhere by clean incisions, which rendered this defence inconsistent, if not impossible. I have known a similar defence made on two other occasions, where the cases came to a trial. In one, a man struck another and knocked him against a window. On examination there were three deep cuts on the face of the prosecutor, but no weapon had been seen in the hand of the prisoner. He was charged with cutting and stabbing. The surgeon deposed that the wounds appeared to have been inflicted with a knife or a razor blade, and not by broken glass. If the wounds had been made by glass, particles of that substance would probably have been found in them; but there were none. The prisoner was acquitted;—the infliction of the wounds by a weapon, not being considered to have been made out. In another case that occurred in August, 1841, the prosecutor was knocked down, and his throat was found severely cut; although there was no proof that a weapon had been used. In the defence, it was urged that the wound had been produced by a broken pane of glass; but the surgeon described it as a clean cut five inches in length, and one inch in depth, laying bare the carotid artery. He considered that it must have been done by a razor or knife; and that it was a cut made by one stroke of the instrument. On the question of the origin of wounds, see the case of *Reg.* v. *Ankers*, Med. Gaz. xxxv. 937.

In general, wounds made by glass, are characterized by their great

irregularity, and the unevenness of their edges. Cases of this kind show that as it is not always possible to know when this sort of defence may be raised, a medical witness should never fail to make a minute examination of a wound which has been criminally inflicted. A trial for murder took place at the Worcester Summer Assizes, in 1838, in which it appeared in evidence, that the deceased had died from a very small punctured wound in the thorax. It was five inches and a half deep, and it had completely traversed the right ventricle of the heart and led to death by hæmorrhage. The wound was supposed to have been produced by a small skewer, which was found near the spot; but in the defence, it was alleged that the deceased had fallen over a tub, and that the wound had been caused by a projecting nail. This allegation, however, was negatived by the surgeon, from the fact of its being a clean cut wound. Had it been produced in the manner alleged by the prisoners, the fact would have been indicated by an irregularity of margin.

Lacerated wounds do not in general present more difficulty with regard to their origin, than those which are incised or punctured. The means which produced the laceration, are commonly well indicated by the appearance of the wound. These injuries are generally the result of accident;—they are, however, frequently met with on the bodies of new-born children, in which case they may give rise to charges of infanticide. *Contused* wounds and severe contusions present much greater difficulty to a medical jurist. It is not often in his power to say, whether a contused wound has resulted from the use of a weapon, from a blow of the fist, or from the deceased having accidentally fallen against some hard surface. This question is frequently put to medical witnesses on those trials for manslaughter, which arise out of the pugilistic combats of half-drunken men. One of the combatants is generally killed, either by a blow on the head, by a fall, or by both kinds of violence combined. The skull may or may not be fractured; and the person may die of concussion, inflammation of the brain, or from extravasation of blood. The general defence is, that the deceased struck his head against some hard substance in falling on the ground; and the surgeon is asked, whether the particular appearances might not be explained on the supposition of a fall. This in general he admits to be possible, and the prisoner is acquitted. A medical witness is rarely in a position to swear with certainty, that a contused wound of the head must have been produced by a weapon and not by a fall. Some circumstances, however, may occasionally enable him to form an opinion on this point. If there be contused wounds on several parts of the head, with copious effusion of blood beneath the skin, the presumption is, that a weapon must have been used. If the marks of violence be on the vertex, it is highly probable that they have been caused by a weapon; since this is not commonly a part which can be injured by a fall.

It has already been remarked, that the law attaches great importance to the clear proof of the use of a weapon; and a medical man has

therefore a serious responsibility thrown upon him, when in the absence of a weapon, he is called upon to say from an examination of the wound, whether one had been used or not. The statute on wounding makes no reference to the means by which wounds are inflicted; but the words are held by the judges to imply in all cases, the use of some weapon or instrument. The following are the provisions of the law. "Whosoever shall *stab, cut or wound* any person, or shall by any means whatsoever, cause to any person, any bodily injury dangerous to life, with intent in any of the cases aforesaid to commit murder, shall be guilty of felony." (1 Vict. c. 85, s. 2.) The word stab is held to import a wound from a *pointed* instrument,—the word cut, from an instrument having an edge; and the word wound comprises incised, punctured, lacerated, contused and gunshot wounds:—thus including all stabs and cuts, and rendering the separate use of these words in the statute wholly unnecessary. All medical men know that stabs and cuts are varieties of wounds; and it is difficult to understand why these terms should have been retained, and the other varieties of wounding, as "incise, puncture, lacerate and contuse," omitted. It has been held that an indictment for cutting will not be supported, if the medical evidence prove that the alleged cut was a stab, and *vice versâ;* and further, in an indictment for cutting and stabbing, it is not sufficient to prove, that it was a contused or lacerated wound. Such technical trivialities are in some measure counteracted by multiplying the counts of an indictment:—but this renders the prosecution of such crimes in a great measure a matter of accident; and creates, without any apparent necessity, difficulties in the medical evidence, by which the accused party only can benefit, and the course of public justice suffer. A medical witness may not always be able to swear to the exact boundary by which a stab is separated from a cut, or a cut from a laceration:—the injury might be considered in either light,—or one medical witness might take one view, and another an opposite view. But while they thus differed on a point, which could not in the least affect the real merits of the case, as between the prosecutor or the public and the accused, they would both agree that the injury was a *wound.* Such difficulties, it is true, seldom occur in practice; but there is no reason why they should ever be permitted to occur; and it is certainly extraordinary that on the revision of the criminal law of this country in 1837, such anomalies should have been retained. See in relation to this subject, the case of *Reg.* v. *O'Brien* argued in the Exchequer Chamber, November, 1844.

A severe wound may, however, be inflicted on a person, and yet, not come within the statute of wounding. Thus the teeth, the hands or feet uncovered, have been held by a majority of the judges not to be weapons; and injuries produced by them, however severe, are not considered wounds within the meaning of the act. Parties have been tried on charges of biting off fingers and noses, and the medical evidence has shown, that great disfigurement and mischief had been done to the prosecutor; but in these cases the degree of injury produced—the di-

vision of the cutis,—is not so much regarded, as the actual method by which it is accomplished. From a trial which took place at the Nottingham Assizes in 1832, it appears that artificial arms and legs are not exempted under the statute. They are considered to be weapons, although in the case alluded to, a strenuous effort was made by the prisoner's counsel to show, that the wooden arm with which the assault was committed, had become, by long use, part of the body of the prosecutor, and like the natural arm it ought not to be considered a weapon in law! The objection was overruled.

We may be often in doubt whether, in respect to lacerated or contused wounds, a *weapon* had been used or not Contused wounds on bony parietes, as on the cranium, have somewhat the appearance of incised wounds, the skin being sometimes evenly separated;—still when the wound is recent, a careful examination will generally enable a witness to surmount the difficulty. If some time have elapsed before the wound is examined, there will necessarily be great caution required in forming an opinion. The following case was communicated to me by a pupil, who gave evidence on the occasion. It was tried at the Chelmsford Spring Assizes, 1837. The prosecutor, it was alleged, had been stabbed on the head with a knife. The prisoner struck the blow, and he certainly had a knife in his hand at the time; but whether the wound was or was not produced by the knife, could not be determined from the evidence of eye-witnesses. In the defence it was urged, that the prisoner had inflicted the wound with his knuckles, and not with a knife. When the surgeon was called to examine the wound there was so much contusion and laceration about its edges, that it was impossible to ascertain, with the necessary legal precision, by what means it had been caused. There was suspicion, but no proof that a weapon had been employed, and the prisoner was acquitted of felony.

A surgeon should be cautious in listening to the statements of others, that a weapon has been used, unless the wound itself bear about it such characters, as to leave that fact indisputable. During a scuffle, the prosecutor may be easily deceived as to the way in which the accused party inflicted a wound upon him,—or a worse motive may sometimes exist for imputing to an assailant the use of a weapon during a quarrel. In such cases we should, as medical witnesses, rather trust to the appearance of the wound for proof of the use of a weapon, than to the account given by interested parties. In a case which was tried *in* 1842 *at the Chelmsford Assizes*, a surgeon swore that a wound on the nose of the prosecutrix, had been produced by a knife, and not by a blow with the fist, as it was alleged in the defence. There seems to have been no good medical reason for the opinion that any knife had been used: it appears to have been founded chiefly on the loose statement of the prosecutrix herself. Nevertheless a conviction followed upon this evidence, and a respectable female, charged as accessory, was sentenced to a severe punishment, not for having assaulted the prosecutrix, for it does not appear that she struck the blow, but for aiding another in the supposed act of stabbing. It was

alleged that she gave a knife to the assailant, when it was extremely doubtful, medically speaking, whether any knife had been used, This case appears to me to convey a strong caution in respect to the medico-legal examination of wounds. A medical man is not justified in giving a hasty opinion of a weapon having been employed from mere hearsay;—he may in this way, lead to the infliction of a very severe but unmerited punishment. The party, when once convicted, cannot at present have the case re-heard by moving for a new trial, or appealing against the verdict:—and unless ably defended, he must suffer from the mistake thus made by a medical witness.

The use of a weapon on these occasions, may be sometimes inferred from the dress having been cut; although it is quite possible that a contused wound may be inflicted by a bludgeon, through the dress, without tearing or injuring it. A wound may be indirectly produced by a weapon, and medical witnesses have often been questioned on this point. Thus the prosecutor may at the time have worn about his person, some article of dress, which received the blow, and this may have caused the wound. On a trial, for maliciously wounding, which took place at the Reading Spring Assizes, in 1837, it appeared in evidence, that the prisoner, while poaching, assaulted a game-keeper, by inflicting on his head, severe blows with a gun. At the time of the assault, the prosecutor wore a strong felt hat, which it was contended in the defence, had caused the wounds that formed the subject of the charge. The medical witness admitted, that the wounds might have been produced either by the hat or the gun. The prisoner was convicted; but the judge intimated a doubt whether this could be considered a "wounding by a weapon," within the statute. In another case, a blow was struck with a bludgeon at the head of the prosecutor, who wore spectacles. Wounds were produced, which it was argued in the defence, had resulted from the glass of the spectacles. The prisoner was acquitted. Every case of this kind must be determined according to the circumstances accompanying it. One fact appears to me to be well established from the foregoing statements, namely, that a medical practitioner should always make a minute and careful examination of wounds, which are likely to become the subject of criminal charges. Before performing his duties as a surgeon, he is bound, so far as he consistently can, to notice their characters, as a medical jurist.

CHAPTER XXVII.

HOW OR BY WHOM WAS THE WOUND INFLICTED?

Supposing that the wound which is found on a dead body, is proved to have been caused before death, it will next be proper to inquire whether it was the result of *suicide*, *homicide*, or *accident*.

It might at first sight be considered, that the determination of a question of this nature, was wholly out of the province of a medical jurist. In some instances it may be so, and the settlement of it is then properly left to the legal authorities; but in a very large number of cases, it is so closely dependent for its elucidation on medical facts and opinions, that juries could never arrive at a satisfactory decision, without medical evidence. Let us suppose then, that a medical jurist is consulted in a doubtful case,—What are the points to which he must direct his attention? These are, with regard to the wound, its *situation*, its *nature and extent*, and its *direction*.

I. The SITUATION OF A WOUND. It is a general principle in which most medical jurists seem to agree, that wounds, inflicted by a suicide, are usually confined to the anterior or lateral parts of the body. The throat and chest are commonly selected where cutting instruments are employed; while the chest, especially in the region of the heart, the mouth, the orbit and the temples, are the spots generally chosen for the perpetration of suicide by fire-arms. But it is obvious, that any of these parts may be also selected by a murderer, with the especial design of simulating a suicidal attempt; therefore, the mere situation of a wound does not suffice to establish the fact of suicide. Wounds which result from accident or suicide are generally in *exposed* parts of the body. A wound in a concealed or not easily accessible part, is presumptive of murder: because this kind of injury could only have resulted from the deliberate use of a weapon. Suicidal wounds are sometimes found in the most unusual situations. In December, 1842, a surgeon destroyed himself by cutting through the brachial artery and the principal veins of his left arm with a penknife; and in another instance which occurred in New York in 1839, a young man committed suicide by dividing the arteries of the fore-arm on both sides. It is very rare that we find suicidal stabs in the abdomen or throat, but an instance occurred a few years since, where a woman destroyed herself by a stab in the lower part of the abdomen; and several similar cases are recorded by medico-legal writers. In an attempt at suicide, which fell under my own observation, a stab was inflicted by a carving-knife on the fore-part of the neck traversing the parts from the trachea to the spinal column. In regard to situation, it has been remarked that there is no wound which a suicide is capable of inflicting on himself, which may not be produced by a murderer; but there are many wounds inflicted by a murderer, which, from their situation, and other circumstances, a suicide would be incapable of producing on his own person. We cannot always obtain positive certainty on this point; the facts will often only allow us to speak with different degrees of probability. The situation of a wound sometimes serves to show, whether it be of an accidental nature or not,—a point often insisted on in the defence. All accidental wounds exist on those parts of the body which are exposed. Some wounds, however, forbid the supposition of accident, even when exposed, as deeply incised wounds of the throat, and gunshot wounds of the mouth and

temples. For an accidental wound on the head by an axe, closely simulating a homicidal wound, see Casper's Wochenschrift, May 24, 1845.

II. NATURE AND EXTENT OF A WOUND.—Generally speaking, the wound met with on the body of a suicide, where firearms have not been used, is incised or punctured. Contused wounds are rarely seen in cases of suicide, because in producing them, there is not that certainty of destroying life to which a self-murderer commonly looks. There are, of course, exceptions to this remark, as where, for instance, a man precipitates himself from any considerable height, and becomes wounded by the fall. Circumstantial evidence will, however, rarely fail to clear up a case of this description. Greater difficulty may exist when life is destroyed by a contused wound, voluntarily inflicted. A case is related by a German author, in which a man first attempted to destroy himself by running with his head against a wall; and not having succeeded in this attempt, he struck himself repeatedly on the forehead with a cleaver. By this, he produced such violent injury to the brain, that death soon followed. The man was seen to commit the crime by several witnesses; had this not been the case, the nature of the wound was such as must have excited a suspicion that it had been inflicted by another, and that the man had been murdered.

A close attention to wounds, made by cutting instruments, will sometimes lead to the development of cases, rendered doubtful from the circumstances under which the dead body of a wounded person is found. A few years since, the body of a respectable farmer was found lying on a high road, in one of the midland counties. The throat was severely cut, and he had evidently died from the considerable hæmorrhage which had taken place. A bloody knife was discovered at some distance from the body, and this, together with the circumstance of the pockets of the deceased having been rifled, led to a suspicion of murder. The suspicion was confirmed when the wound in the throat was examined by a surgeon. It was cut, not as is usual in suicides, by carrying the cutting instrument from before backwards, but as the throats of sheep are cut, when slaughtered by a butcher. The knife had been passed in deeply, under and below the ear, and had been brought out by a semicircular sweep in front, all the great vessels of the neck, with the œsophagus and trachea, having been divided from behind forwards. The nature of this wound rendered it at once improbable that it could have been self-inflicted; and it further served to detect the murderer, who was soon afterwards discovered. The prisoner, who was proved to have been a butcher, was subsequently tried and executed for the crime.

It is necessary to bear in mind, that maniacs, when they commit suicide, often inflict upon themselves wounds of a very extraordinary nature, such as would, at first view, lead to a suspicion that they had been produced by the hand of a murderer: and, therefore, the rules which are here laid down to distinguish homicidal from suicidal wounds, must be very guardedly applied to the cases of those individuals who are known to have laboured under insanity. Perhaps one of the most

remarkable cases of this kind, is that recorded by Mr. Tarleton. (Med. Gaz. xxiv. 276.)

The extent of a wound, by which we are to understand the number and importance of the parts injured, must always in these cases be taken into consideration. It has been somewhat hastily laid down as a rule, that an extensive wound of the throat, involving all the vessels and soft parts of the neck to the vertebral column, could not be inflicted by a suicide. Although in general, suicidal wounds of this part of the body, do not reach far back or involve the vessels of more than one side, yet we find occasionally that all the soft parts are completely divided to the vertebræ. These are cases, in which perhaps with a firm hand, there is a most determined purpose of self-destruction. In a case of suicide, observed by Marc, the weapon had divided all the muscles of the neck, the larynx and œsophagus, had opened the jugular veins, and both carotid arteries, and had even grazed the anterior vertebral ligaments. A wound so extensive as this, is certainly rarely seen in cases of suicide; but there is no ground for the assertion, that these extensive wounds in the throat, are at all incompatible with self-destruction.

Incised wounds in the throat are generally set down as presumptive of suicide; but murderers sometimes wound this part for the more effectual purpose of concealing the crime. Circumstances, connected with the form and direction of the wound, often, in such cases, lead to detection; for unless the person attacked, be asleep or intoxicated, resistance is offered,—evidence of which may be obtained by the presence of great irregularity in the wound or the marks of other wounds on the deceased. In some instances, it is extremely difficult to say, whether the wound be homicidal or suicidal,—the medical facts being equally explicable on either hypothesis. (See case by Marc, Ann. D'Hyg., 1830, ii. 408 :—another by Devergie, ib. 414; and a third by M. Ollivier, Ann. D'Hyg., 1836, i. 394.) *Regularity* in a wound of the throat has been considered to be presumptive of suicide. This was the publicly-expressed opinion of Sir Everard Home, in the well-known case of *Sellis*. The deceased was found lying on a bed, with his throat extensively cut; and the edges of the incision were regular and even. This condition of the wound, it was inferred, repudiated the idea of homicide: but as a general principle, it appears to me to be a fallacious criterion. A murderer, by surprising his victim from behind,—by having others at hand to assist him, or by directing his attack against one who is asleep or intoxicated, or who from age or infirmity, is incapable of offering resistance, may easily produce a very regular and clean incision on the throat. This was observed in the case of *Lord William Russell*, who was murdered by Courvoisier in 1840. The wound in the throat possessed all that regularity which has been so improperly regarded as characteristic of suicide. Many, indeed, have taken a directly opposite view to that advocated by Sir E. Home: and have contended with more plausibility, that the chief character of a suicidal wound in the throat, is great irregu-

larity from want of steadiness in the hand, during the perpetration of suicide. It is by no means unusual in suicide, to find the cut regular at its commencement, and irregular and uneven at its termination, from the loss of blood which attends the first incision; but it is obvious, that a homicidal wound might possess these characters. In short, from the foregoing remarks, we are, I think, entitled to say, that regularity or irregularity in an incision in the throat, furnishes no presumptive evidence either of homicide or suicide. The nature or the extent of a wound or of other injuries on the person, will sometimes allow us to distinguish very positively, *accident from homicide*. These personal injuries may be such, that they could not possibly have had a suicidal or accidental origin.

A few years ago, I assisted in examining the body of a woman, who was alleged to have been murdered by her husband. The body presented the numerous marks of contusions; one arm was completely ecchymosed from the shoulder to the hand. The person charged with the murder, ascribed these appearances to the fact of his wife having accidentally fallen out of bed; but on examining the bed it was found to be only a foot from the floor. A fall from this height, would not account for the presence of such extensive marks of violence; but irrespective of this, a severe contusion was found on the outer side of the opposite thigh, which, from the appearance, must have been produced about the same time as that on the arm. The existence of this second contusion, rendered the defence still less probable; for the woman could not, if she had fallen at all, have fallen on both sides of her body at once; and it was not alleged that she had had more than one fall. In the case of the *Queen* against *Wallis*, (Cent. Crim. Court, 1839,) a similar defence was set aside, by the fact that severe bruises were found at the same time on the occiput and the temples of the deceased.

III. The DIRECTION of a wound.—The direction of a wound has been considered, by some, to afford presumptive evidence, sufficiently strong to guide a medical jurist in this inquiry. It has been remarked that in most suicidal wounds which affect the throat, the direction of the cut is commonly from left to right, either transversely or passing obliquely from above downwards: in suicidal stabs and punctured wounds, the direction is commonly from right to left, and from above downwards. In left-handed persons, the direction would, of course, be precisely the reverse. Suicidal wounds are, however, subject to such variation in extent and direction, that it is scarcely possible to generalize with respect to them. Nevertheless, an attention to these minutiæ, may sometimes be of real assistance to the inquirer, especially when the body has not been moved from its position. It is recommended that the instrument with which the wound has been inflicted, should be placed in either hand of the deceased, and the extremity moved towards the wounded part, so that it may be clearly seen whether or not, the direction of the wound could correspond to it in any position. It might happen that neither arm would reach the wounded part, so as to inflict a wound of the particular direction observed; this may be the case in wounds situated on the back. It is obvious that if a murderer makes an incised wound in the throat from behind, the direction will be the same as that commonly observed in cases of suicide. (See on this point the case of *Reg.* v. *Dalmas*, Cent. Crim. Court, May, 1844.) Again, if the person attacked be powerless, the wound

may be deliberately made, so as to simulate a suicidal act; indeed murderers would seldom attack the throat, but with the design of simulating an act of suicide. A homicidal stab, may also take the same direction as one which is suicidal; but this would be confined to those cases, where the murderer was placed behind or aside. If in front of the person whom he attacks, the direction would probably be from left to right; but in suicide, where the right hand is commonly used, it is the reverse. All oblique wounds, passing from above downwards, are common to homicide and suicide; but those which take an oblique course from below upwards, are generally indicative of homicide; it is at least extremely rare, that a suicide, unless a lunatic, thus uses a weapon. Homicidal incisions, especially in the throat, are often prolonged below and behind the skin forming the angles of the wound, deeply into the soft parts. Those which are suicidal, rarely possess this character; they terminate gradually in a sharp angle, and the skin itself is the furthest point wounded,—the weapon is not carried either behind, below, or beneath it. Exceptions to these characters may exist; but in a dark and intricate subject of this nature, we have only these limited rules to guide us. The instrument with which the wound is supposed to have been inflicted, should be adapted to the edges of the incision: its sharpness may be compared with the cleanness and evenness of the cut, and its length with the depth of the incision or stab. It is no uncommon occurrence for a murderer to substitute some instrument, belonging to the deceased or another person, for that which he has employed.

Some remarks have been made about the direction of a cut or a stab, varying according to whether the right or the left hand has been used by a suicide. It is important for a medical jurist to be aware, that there are many persons, who are *ambidextrous*, i. e. who have equal facility in the use of the right or the left hand. This may not be generally known to the friends of the deceased: and such persons are often pronounced even by those who have associated with them, to have been right-handed. A want of attention to this point, is said to have been one of the circumstances which led to a suspicion of murder in the case of *Sellis*. (Wills. Circ. Evidence, 97.) He was found dead on his bed with the throat cut,—the razor was discovered on the left side of the bed; whereas, it was generally supposed and asserted, that he was a right-handed man. The truth was, he was ambidextrous, equally expert in the use of the razor with his left and right hand; and thus the apparently suspicious circumstance of the razor being found on his left side, was at once explained away. Severe incisions on vital parts do not often happen by accident; but severe punctures and stabs affecting vital organs, have frequently an accidental origin. These stabs arise generally from falls, while the individual is in the act of running, with a pointed instrument in his hand or his pocket. There is one character which, when thus produced, they are commonly observed to possess, namely, that their direction is from below upwards. In this way, the truth of a defence

may be sometimes tested, as where a prisoner alleges, that the deceased threw himself, or fell upon the weapon. Homicidal stabs may be likewise directed from below upwards; but this is somewhat rare, and not probable, unless an individual be stabbed by an oblique blow, while in the recumbent posture. Rules of this kind may appear to be susceptible of but little practical application; yet cases do occasionally present themselves, wherein a close attention to the situation and direction of wounds, may materially assist a medical jurist in forming an opinion. In a case of alleged murder, which was tried in 1843 at the Central Criminal Court, the surgeon deposed, that he found on examining the body of the deceased, a stab on the left side of the chest, near the armpit, about six inches in depth. It had wounded the right lung, and had penetrated obliquely into the right auricle of the heart, passing from left to right. He contended, very properly, that considering the situation and direction of the wound, it was very improbable the deceased could have inflicted it upon himself. The fact that there may be some instances in which rules of this kind will not be applicable, must not deter us from endeavouring to make a cautious application of them in doubtful cases. The following case shows how an accidental may simulate a homicidal stab. A blacksmith while forging a piece of rod-iron became irritated at some observations made by a bystander. In making a rush at the offender with the piece of iron in his hand, the end being red hot, he stumbled and fell. In some way the piece of iron became accidentally reversed,—he fell upon the point which struck against the upper portion of the breast-bone glanced from that and penetrated the upper part of the left lung. He died in a few days and the body was examined by order of the coroner. Had only one person been present when this circumstance occurred a charge of murder might easily have arisen, and the circumstantial evidence might have appeared to favour this view. (Dublin Med. Press, January, 1845.) Mr. B. Cooper relates a case in which a man accidentally inflicted upon himself a stab under very singular circumstances. (Med. Gaz. xxxvi. 264.) See also a case by M. Ollivier, Ann. D'Hyg., 1843, ii. 169.

IV. THE PRESENCE OF SEVERAL WOUNDS.—In suicides, commonly one wound only is seen, namely, that which has destroyed life; and the presence of several wounds on a body, or the marks of several attempts around the principal wound, have been considered to furnish presumptive evidence of murder. But it need hardly be observed, that any inferences of this kind must be very cautiously drawn; since not only may a murderer destroy his victim by one wound, but a suicide may inflict many, or leave the marks of several attempts, before he succeeds in his purpose. A case is reported in which a gentleman, labouring under mania, attempted to destroy himself. Besides many wounds on the fore-arm, neck, and face, which disfigured him, there were twenty-two in front of his chest. One of these had traversed the heart, producing death after some hours, by causing extravasation of blood. (Lancet, July, 1839.) In incisions on the throat, from igno-

rance of the situation of vital parts or from tremulousness, a suicide often produces one or more incisions of greater or less extent, near that which destroyed him. This is especially the case, when the instrument happens first to lodge on the cartilages of the larynx. The same remark applies to suicidal stabs, when the point of the weapon, in being directed against the chest, comes in the first instance in contact with the ribs. With respect to the throat, many cases might be cited, where two, three, and even six or more incisions, have been made in this part by suicides, before they have destroyed themselves. A very remarkable case is related by Dr. Handyside, (Ed. Med. and Surg. Jour. Jan. 1838,) in which a gentleman, who had studied medicine, destroyed himself by inflicting several wounds on his throat. Incisions were found on each side, just below the angle of the jaw, and in the hollow behind it. They were irregular in form, and bore the character of deep stabs. The only important vessel divided, was the internal jugular vein on the right side; but, nevertheless, a large quantity of blood was lost, and this, no doubt, as it is stated by Dr. Cormack, was the real cause of death. The case is in many points of view singular: for such wounds have never before, so far as I know, been found in cases of suicide. It would appear that the deceased was ambidextrous, and that the wounds on each side of the neck were inflicted by the hand of the opposite side. The following case which occurred in London, in 1839, is somewhat similar. A lady who had been for several days in a despondent state, was found one morning dead in her bed in a sitting posture. On examination, two very deep and extensive wounds, which had divided the principal blood-vessels, were perceived on the right side of the neck. There were two penknives on the bed, covered with blood. From the situation and other characters of the wounds, it was inferred that they must have been inflicted with the left hand; although nothing satisfactory could be ascertained on this point. The husband and son had slept in the adjoining room. There was no doubt that this was a case of suicide, although it is singular, that two deep wounds should have been found thus inflicted by two different weapons on the right side of the neck, in the case of a person who was not known to be left-handed.

In general, suicides when foiled in a first attempt, continue to use the same weapon; but sometimes, after having made a severe incision in the throat, they will shoot themselves, or adopt other methods of self-destruction. These cases can only appear complicated to those, who are unacquainted with the facts relative to self-murder. Neither the presence of several wounds by the same kind of weapon, nor of different wounds by different weapons, can be considered of themselves, to furnish any proof of the act being homicidal. One instance is reported, in which a lunatic, in committing suicide, inflicted thirty wounds upon his head. (Med. Gaz. xxiv. 276.) In a case of murder, when many wounds are found on a dead body, it may happen that the situation or direction of some, will be incompatible with the idea of a suicidal origin. The following case occurred at New York,

in September, 1839. A woman was found dead, and there were many wounds upon her body. The husband was suspected of having killed his wife, but he asserted that she had destroyed herself. This defence, however, was shown to be inconsistent with the medical facts. Three physicians who examined the body, deposed that there were eleven wounds (stabs,) eight on and about the left side of the thorax, one of which had penetrated the pericardium, and divided the trunk of the pulmonary artery at its origin; and the others were on the back, near the left scapula. It was quite impossible, that these last-mentioned wounds could have been produced by the deceased, and there was every reason to suppose that the stabs in front and at the back, had been inflicted at the same time by the assassin.

When we find on the body of a suicide, several wounds, it generally happens that one only bears about it a *mortal* character, namely, that which has caused death. On this account, it has been asserted by some medical jurists, that when two mortal wounds are found upon a body, and particularly if one of them be of a stunning or stupefying tendency, (i. e., affecting the head,) they must be considered incompatible with suicide. An inference of this kind can be applied to those cases only, in which the two wounds, existing on different parts of the body, were likely to prove immediately fatal. It must, however, be borne in mind, that all suicides do not immediately perish from wounds which are commonly termed mortal; on the contrary, they have often the power to perform acts of volition and locomotion, which might by some, be deemed wholly incompatible with their condition. It is very difficult to say, whether one wound was likely to destroy life so rapidly, as to render it impossible for an individual to have inflicted another upon himself. There are no rules by which, in unknown cases, the instantaneous mortality of wounds, can be accurately determined,—a fact which will be apparent hereafter from a description of cases of wounds of the head, heart and throat.

Again, it is not possible to say from the mere discovery of marks of contusion or injury on the head, that the deceased must have necessarily laboured under concussion, and have therefore been afterwards unable to inflict any other wound upon himself. Injuries of the head are attended with the most singular anomalies in this respect. One individual will be rendered insensible and powerless from a blow, which leaves scarcely any appreciable marks, while another will be able to walk and exert himself, when the skull has been fractured and depressed, and even when a portion of brain has been lost; in short, the appearances may be such, as to induce many surgeons to express an opinion, that death must have taken place instantaneously. It is quite right, that a medical jurist should be fully prepared for the occurrence of such anomalous cases; but a strong suspicion of homicide may fairly exist when, besides marks of great injury to the head, a severe cut or a stab, is found on the body. A man is not likely to cut or stab himself after having sustained such severe violence to the head; but it is quite possible that he may have the power

of precipitating himself from an elevated spot, and thereby of producing great injury to the head, after having previously attempted to cut his throat or to stab himself. That this may happen, will be apparent from the following case, which occurred in this city in 1836. A man was found one morning lying dead in the street in a low quarter of the town, with his skull severely fractured, and his throat cut. The evidence adduced at the inquest, satisfactorily showed, that the deceased had attempted suicide by cutting his throat in his bed-room, and had then thrown himself out of the window, by which the fracture and other severe contusions, found on his body, were produced. Had the body of this person been thus discovered in a lonely and sequestered spot, the presumption would certainly have been in favour of murder. Cases of this description are usually determined by circumstantial evidence. In the following instance there could be no doubt of homicide. A woman was found dead nearly twelve months after she was first injured. Her body was clearly identified. A handkerchief was drawn tightly round the neck, and a wound from a pistol-ball was traced through the left side of the chest, passing out at the right orbit; and three other wounds were found, one of which had entered the heart, and all of which had been made by a sharp instrument. The prisoner charged with the crime, alleged that the deceased had committed suicide—but the variety of the means and the instruments employed to produce death, as well as the fact that the gun-shot wound in the head, the stab in the heart, and the act of strangulation were individually sufficient to account for speedy death, left no doubt that this was an act of murder. (The *King against Corder*, Bury Summer Assizes, 1828. Will's Circ. Evidence, 237.)

When several wounds are found on a dead body, the question is frequently asked,—Which was first received? If one be what is commonly called mortal, and the others not, it is probable that the latter were first inflicted. This remark applies both to cases of homicide and suicide; but it is apparent, that where in a murderous assault, a person has been attacked by several individuals at once, the wounds may have been simultaneously produced. This is, however, a question to which it is not easy to give a general answer. Each case must be decided from the special circumstances attending it; and in most instances, unless some direct evidence be afforded, a medical opinion can be little more than conjectural. I here refer to it, because it is a question almost always put in a Court of law; and a witness should at least prepare himself for it, by a proper examination of the medical circumstances of the case.

CHAPTER XXVIII.

CIRCUMSTANTIAL EVIDENCE.

In pursuing the examination of the question respecting the homicidal or suicidal origin of wounds, I shall call the attention of the reader to the force of evidence which is sometimes derived from the circumstances under which the body of a person, dead from wounds, is discovered. It may be said that this is a subject wholly foreign to the duties of a medical jurist, but I cannot agree to this statement; there are very few in this profession, who, when called to aid justice, by their science, in the detection of crime, do not seek for circumstances by which to support the medical evidence required of them. A practitioner would certainly be wrong to base his professional opinion exclusively on circumstantial proofs; but it is scarcely possible for him to avoid drawing an inference from these, as they fall under his observation, for or against the prisoner. His evidence may be of itself weak, and insufficient to support the charge against an accused party; in such a case, if any suspicious circumstances have come to his knowledge, he may be often unconsciously induced to attach greater importance to the medical facts than he is justified in doing; in short he may, through a feeling of prejudice, which it is not always easy to avoid, give an undue force and value to the medical evidence. But if a proper degree of caution be used in drawing inferences from the circumstantial proofs, and they are not allowed to create a prejudice in his mind against a prisoner, a practitioner is, I think, bound to observe and record them; for being commonly the first person called to the deceased, many facts, capable of throwing an important light on the case, would remain unnoticed or unknown, but for his attention to them. The position of a dead body,—the distance at which a knife or pistol is found,—the direction of the instrument,—whether situated to the right or left of the deceased,—the marks of blood about the person, clothes, or furniture of the apartment, are all circumstances which must assist materially in developing the real nature of a case, and giving force to a medical opinion. Many of these circumstances can fall under the notice of him only who is first called to the deceased; and, indeed, if observed by another, no advantage could be taken of them without the assistance of a medical man. Thus, he may be asked: Is the position of a wounded body that which a suicide could have assumed? Is the distance of the fatal

weapon from the body, such as to render it improbable that it could have been placed there by the deceased?—in answering either of which questions, he must take into consideration the extent of the wound, and the period at which it probably proved fatal. Again, it may be inquired: Has the deceased bled in more places than one?—Are the streams of blood all connected?—Are there any marks of blood on his person or clothes, which he could not well have produced himself? These are questions, the answers to which may materially affect the case of an accused party; and the practitioner, in noticing and recording the circumstances involved in them, ought therefore to exercise due caution and deliberation. "The consideration of the nature of circumstantial evidence," observes Starkie, "and of the principles on which it is founded, merits the most profound attention. It is essential to the well-being at least, if not to the very existence of civil society, that it should be understood, that the secrecy with which crimes are committed, will not insure impunity to the offender. At the same time, it is to be emphatically remarked, that, in no case, and upon no principle, can the policy of preventing crime, and protecting society, warrant any inference which is not founded on the most full and certain conviction of the truth of the fact, independently of the nature of the offence and of all extrinsic considerations whatever. Circumstantial evidence is allowed to prevail to the conviction of an offender, not because it is necessary and politic that it should be resorted to, but because it is in its own nature capable of producing the highest degree of moral certainty in its application. Fortunately for the interests of society, crimes, especially those of great enormity and violence, can rarely be committed, without affording vestiges by which the offender may be traced and ascertained. The very measures which he adopts for his security, not unfrequently turn out to be the most cogent arguments of guilt. On the other hand, it is to be recollected, that this is a species of evidence which requires the utmost degree of caution and vigilance in its application; and, in acting upon it, the just and humane rule, impressed by Lord Hale, cannot be too often repeated:—tutius semper est errare in acquietando quam in puniendo, ex parte misericordiæ quam ex parte justitiæ." (Vol. i. p. 480.) Evidence is *direct* when a fact is proved by witnesses and *circumstantial* when the fact is at once proved by circumstances. More commonly the evidence is *presumptive*, i. e. founded on an inference from circumstances.

There are many cases on record in which an observance of slight and unexpected circumstances by medical men, has led to the detection of offenders. In the life of Sir Astley Cooper, it is mentioned, that when called to see *Mr. Blight*, of Deptford, who had been mortally wounded by a pistol-shot in the year 1806, he inferred from an examination of the localities, that the shot must have been fired by a *left-handed* man. The only left-handed person near the premises at the time was a Mr. Patch, a particular friend of the deceased's, who was not in the least suspected. This man was afterwards tried and convicted of the crime,

and made a confession of his guilt before execution. Among the circumstances to which a medical witness should specially direct his attention, are the following :

I. THE POSITION OF THE BODY.—The body may be found in a position which the deceased could not have assumed on the supposition of the wound being accidental or suicidal. The position of a dead wounded body, is often only compatible with homicidal interference, either at the time of death, or immediately afterwards. In order to determine the probable time of death, we should always notice whether there be any warmth about the body,—whether it be rigid, or in a state of decomposition, and to what degree this may have advanced.

II. THE POSITION OF THE WEAPON.—If a person has died from an accidental or self-inflicted wound, likely to cause death either immediately or within a few minutes, the weapon should be found either near the body or within a short distance. If found near, it is proper to notice on which side of the body it is lying ; if at a short distance, we must consider whether it might not have fallen to the spot, or been thrown or placed there by the deceased. If there has been any interference with the body, all evidence from the relative position of it and the weapon, will be inadmissible. In a case which was referred to me some time since, a woman had evidently died from a severe incision on the throat, which was homicidally inflicted ; the weapon, a razor, was found under the left shoulder, a most unusual situation, but which, it appears, it had taken from the body having been turned over before it was seen by the surgeon who was first called. We must remember, that it is quite compatible with suicide, that a weapon may be found at some distance or in a concealed situation, but it is commonly either grasped in the hand, or lying by the side of the deceased.

In one instance, it is stated the deceased was discovered in bed with his throat cut, and the razor lying *closed* or shut by his side. It appears very improbable, that any person committing suicide after dividing one or both carotids with the jugular veins, should have power to close or shut the razor, and there is fair ground to suspect interference when a razor is thus found closed, and the body has not been interfered with. There is, however, one circumstance in relation to a weapon strongly confirmatory of *suicide*. If the instrument be found still firmly grasped in the hand of the deceased, no better circumstantial evidence of suicide can, perhaps, be offered. It is so common to find knives, razors and pistols grasped in the hands of suicides, that it is quite unnecessary to produce cases illustrative of this statement. The grasping of a weapon appears to be owing to muscular spasm persisting after death, and manifesting itself under the form of what has been called cadaverous spasm, a condition quite distinct from rigidity, although often running into it. It does not seem possible that any murderer could imitate this state, since the relaxed hands of a dead person cannot be made to grasp or retain a weapon, like the hand

which has firmly held it by powerful muscular contraction, at the last moment of life. In this respect the case of *Reg. v. Saville,* Nottingham Summer Assizes, 1844, is of great interest to the medical jurist. A woman was found dead with her throat cut, and there was a razor *loose* in her hand. There was no blood upon the hand which held the razor, and this, together with the fact of its being loose, rendered it certain that it must have been placed there by the prisoner after having cut his wife's throat. The deceased may be found with some other article grasped in the hand. (See case Ann. D'Hyg. 1829. i. 464.) It may be her own or the prisoner's hair torn off in the struggle for life. On this point a question of identity may be raised. *Reg. v. Ellison,* Bodmin Summer Ass. 1845.

If the weapon cannot be discovered, or if it be found concealed in a distant place, this is strongly presumptive of homicide, provided the wound be of such a nature as to prove speedily fatal. In the case of *Lord William Russell,* no weapon could be discovered ; and although the wound in the throat bore some of the characters of a suicidal incision, this fact alone was sufficient to show that it must have been the act of a murderer. With respect to the weapon being found at a distance from the body, other circumstances should be taken into consideration, before any opinion is expressed. We may observe, whether the weapon, if a sharp cutting instrument like a razor, has been recently notched ; for this might show that a degree of force or violence had been used, not easily reconcilable with the suicidal use of the instrument. The well-known case of the *Earl of Essex,* who was found dead in the Tower, in July, 1683, gave rise to a doubt on this point. The deceased was discovered with his throat cut, and a razor lying near him. This razor was found to be much notched on the edge, while the throat was smoothly and evenly cut from one side to the other, and to the vertebral column. Some considered this to have been an act of suicide, others of murder. Those medical witnesses, who supported the view of suicide, were asked to explain how it was that such an even wound could have been produced by a notched razor. They attempted to account for this by asserting, that the deceased had probably drawn the razor backwards and forwards across the neck-bone, forgetting that before this could be done by a suicide, all the great vessels of the neck must have been divided !

It does not always happen, that the weapon with which a wound has been produced, is covered with blood. It has been remarked, that in the case of stabs, the knife is frequently without any stains of blood upon it ; or there is only a slight film, which, on drying, gives to the surface a yellowish brown colour. The explanation of this appears to be, that the weapon, in being withdrawn, is sometimes cleanly wiped against the edges of the wound in the integuments.

III. Marks of blood.—It is proper to notice all marks of blood on the person or in the apartment, and to observe where the greatest quantity of blood has been effused ; this is generally found in the spot, where the deceased has died. The deceased may have bled in

more places than one: if so, it becomes important to notice, whether there be any communications in blood between these different places. Blood on distant clothes or furniture, will show, whether the deceased has moved about; and whether he has struggled much after receiving the wound. Acts of locomotion in a wounded person, who has died from hæmorrhage, are generally indicated by tracks of blood. We must observe likewise, whether if the wound be in the throat, blood has flowed down in front of the clothes or person; for this will sometimes show whether the wound was inflicted when the individual was standing, sitting, or lying down. If the throat be cut, while a person is lying down, it is obvious that the blood will be found chiefly on either side of the neck, and not extending down the front of the body. Few suicides cut the throat while in the recumbent posture, and the course which the blood has taken, may, therefore, be sometimes rendered subservient to the distinction of a homicidal from a suicidal wound. The position in which the body was, when the wound was inflicted, is a frequent question on inquests and criminal trials. In the case of *Lord William Russell*, the throat had evidently been cut while the deceased was lying in bed; the blood was effused on each side of the neck only. There was also found a wound on the thumb of the right hand of the deceased, which must have been inflicted at the time the hand was put up to defend the throat. Recent wounds on the back of one or both hands, when found in persons who have died from wounds in the throat, are cæteris paribus strongly presumptive of homicide. For an interesting case by Marc, illustrative of these remarks, see Ann. D'Hyg., 1829, i. 465. In suicidal wounds of the throat, we frequently find the head of the deceased hanging over or near a vessel placed purposely to receive the blood.

It is possible that the throat of a person while standing, sitting, or kneeling, may be cut by a murderer from behind, and thus in appearance simulate suicide. It does not, therefore, follow that on these occasions the clothes of the assassin would be necessarily covered by blood: for whenever the attack is made from behind, few or no stains may be found upon his dress. This, of course, must depend upon his position in relation to the deceased at the time of inflicting the wound. In entire violation of this simple principle, the fact of a prisoner's clothes not being marked with blood, was recently urged as a proof of innocence! *Reg. v. Dalmas*, C. C. C., June, 1844. When the deceased has been wounded with his clothes on, we should notice whether or not any part of his dress has been cut or injured over the situation of the wound. When, together with the wound in the throat, we find the cravat and the shirt or any part of the dress, cut through, this is, all other circumstances being equal, presumptive of homicide; for it is not usual that any suicide, unless labouring under confirmed insanity, would be likely to allow any mechanical obstacles of this kind to remain in the way of a weapon. In one case of a homicidal wound in the throat, inflicted in the recumbent posture, the cravat of the

deceased had been lifted up and afterwards allowed to drop over the wound. Marks of blood on the person of the deceased require special observation. Very often the impression of a hand or of some of the fingers, will be found on the skin in a situation where it would have been improbable or impossible for the deceased to have produced it, even supposing that one or both of his hands were covered with blood. In one case of murder, there was found the bloody impression of a left hand upon the *left hand* of the deceased, in such a situation, that it was quite impossible the deceased himself could have made the mark! In other cases it may be important to state whether the inside or outside of the hand, or whether one or both hands, be marked with blood.

In judging from marks of blood in the apartment, we must take care that we are not unconsciously misled by the accidental diffusion of this liquid by persons going in and out. The following case, which will show the necessity of extreme caution, occurred recently in France. A young man was found dead in his bedchamber, with three wounds on the front of his neck. The physician who was first called to see the deceased, had, unknowingly, stamped in the blood with which the floor was covered, and had then walked into an adjoining room, passing and repassing several times; he had thus left a number of bloody foot-prints on the floor. No notice of this was taken at the time; but on the following day, when the examination was resumed, the circumstance of the foot-prints was particularly attended to, and excited a suspicion that the young man had been murdered. The suspected person was arrested, and would have undergone a trial on the charge of murder, had not M. Marc been called in, to examine all the particulars of the case A similar circumstance occurred in the case of *Eliza Grimwood*, who was murdered at Lambeth, in June 1838.

It is scarcely possible to distinguish *arterial* from *venous* blood, when it has been for some days effused and has fallen upon articles of dress or furniture; but this in medico-legal practice is not often a subject of much importance, since there are few cases of severe wounds, either in the throat or other parts of the body, in which the two kinds of blood do not escape simultaneously. The most striking and apparent difference between them, is the colour,—the arterial, being of a bright scarlet, while the venous, is of a deep red hue; but it is well known, that the latter, when exposed to air for a short time, acquires an arterial colour. If the coat or other stuff, covered with blood, were of a dark colour, the liquid would be absorbed and lose its physical characters. Chemistry does not enable us to apply any test, so as to make a satisfactory distinction between them. The only case in which this question ever arose to my knowledge, was in that of *Sellis*, who attempted to assassinate the Duke of Cumberland, and then destroyed himself. Sir Everard Home undertook to say, that the marks of blood on the coat of Sellis, had evidently proceeded from a wounded artery, and that the blood had probably come from the tem-

poral artery of the Duke, which had been divided in the struggle. This distinction appears to have been founded on the fact, that the blood poured out from an artery becomes sprinkled over a surface, and that it does not fall in a gushing stream, like hæmorrhage from a vein. (Will's Circ. Ev. 98.) Such a criterion appears to me to be scarcely available for practical purposes; since accident may lead to the sprinkling of blood from a wounded vein, while blood may be poured out in considerable quantity from an artery, especially if large; and if it fall on one spot at a short distance, it may produce a soaked appearance. The sprinkling may be expected only when the wounded artery is small, and the blood is effused at a distance. This is a fact which a medical jurist should not overlook, although for the reasons stated, too great a reliance must not be placed on it. The spots of blood, if thrown out from a living blood-vessel, speedily consolidate, and the fibrin, with the greater portion of the colouring matter, is found of a deep red colour at the lower part of the spot, the upper portion being of a pale red. The lower and thicker part has commonly a shining lustre, as if gummed, when the spot is recent. The colour after a few days, will not enable us to say whether the spot be due to arterial or venous blood.

When spots of blood are found upon articles of dress or furniture, their *form* may sometimes serve to give us an indication of the position of the wounded person with respect to them. Thus when the form of a spot is oval and elongated, the presumption is that the person was placed obliquely with respect to the stained furniture, during the hæmorrhage. (Ann. D'Hyg. 1840, 397.) The impetus with which the blood is thrown out will be in some measure indicated by the degree of obliquity and length of the spot. This is in general wide and rounded at the upper part, but narrow and pointed below.

In these investigations, it is not often that any difficulty is experienced in distinguishing a *suicidal* from an *accidental* wound. When the wound has really been suicidally inflicted, there are generally to be found about it very clear indications of design; and the whole of the circumstances are seldom reconcilable with the supposition of accident. But if the position of the deceased with respect to surrounding objects, has been disturbed,—if the weapon has been removed, and the body transported to a distance, then it will not always be easy to distinguish a wound accidentally received, from one inflicted by a suicide or a murderer. The evidence of those who find the body can alone clear up the case; and the medical witness may be required to state how far this evidence is consistent with the situation, extent and direction of the wound by which the deceased has fallen. It is unnecessary to dwell further on this subject, since the observations made in the preceding pages, will suggest to the practitioner the course which he has to pursue. Circumstantial evidence is commonly sufficient to show whether a wound has been accidentally received or not; but as an accidental wound may sometimes resemble one of homicidal or suicidal origin, so it follows that it is not always possible for a medical

jurist to decide the question peremptorily from a mere inspection of the wound. Homicide is only liable to be confounded with accident in relation to *contusions* and *contused* wounds. In cuts and stabs the evidence of design will be in general too apparent to allow of any doubt being entertained upon the real origin of the injury. It would not be difficult to produce many instances where murderers, in their defence, have alleged that the wounds observed in the bodies of their victims were of accidental origin, and the allegations have been clearly refuted by medical evidence. A witness must be prepared, therefore, in all cases where death has taken place in secrecy, and the nature of the wound is such as to render its origin doubtful, to be closely examined by the counsel of a prisoner charged with felonious homicide, as to whether the wound might not have been accidental. Our law requires that it should be rendered evident to a jury, before such a charge can be sustained, that the fatal wound could not have been accidental or suicidal. Hence this preliminary question is deserving of serious attention from a medical jurist.

The death of a party, from wounds, has been hitherto considered as a subject connected with a criminal charge; but an investigation of the circumstances under which death ensues, is occasionally rendered necessary when the deceased has effected an insurance upon his life. A policy of life-insurance is in some cases rendered void by the act of self-destruction; and therefore an individual, bent on suicide, might, for the sake of his family, take precautions to conceal the manner in which he intended to destroy himself. His body might be found wounded in a way which would render it uncertain whether he had been wounded accidentally, whether he had been murdered, or whether he had fallen by his own hand. In a disputed case, it is incumbent on the office to prove the act of suicide (*felo de se*), while the relatives of the deceased would attempt to show the contrary. Such litigation must, of course, call forth a most deep and searching investigation into all the circumstances connected with the death of an insured party, and the whole case would, in some instances at least, rest almost exclusively on medical evidence. (Med. Gaz. xxxvi. 826.) Numerous cases have of late years occurred in England, which will illustrate the importance of attending to the precise characters of wounds, and the circumstances under which the body of a wounded person is found. The limits of this work will not allow me to do more than advert briefly to a few of the more remarkable of these.

In the year 1837, Mr. Dodd, of Chichester, communicated to me the following case. He was called to examine the body of a woman, who was found dead with her throat cut. The deceased, when seen by him, was lying on her back, and the razor with which the wound was inflicted, was found under the left shoulder. On inquiry, it was ascertained that when first seen, she was lying on her face, and the body had been turned round on its back. Blood had evidently run down the fore-part of her person, rendering it probable that she had been wounded while in the erect position. The incision in the throat was deep and extended obliquely from the right side of the chin, to within about an inch of the left collar-bone. It had divided the windpipe, the gullet, all the muscles of that side of the fore-part of the neck,—the carotid ar-

tery, jugular vein, and the muscles on the fore-part of the spine, penetrating even into the bodies of the cervical vertebræ. The incision was double, one superficial close under the chin, and the other, the deeper one, appeared to be continued from this. The deepest part of the right end of the incision was nearly three inches in a direct line behind the right angle of the wound, so that it extended at that part behind and beneath the sound skin. The cut was four and a-half inches long, and two and a-half deep. The main question was, whether this could have been a suicidal wound, inflicted by the razor, the only weapon found near the body. Considering its characters, Mr. Dodd inferred that it must have been inflicted by another person, and not by the deceased upon herself. The deceased was right-handed, which would add to the difficulty of supposing the wound to have been suicidal. The inference drawn was precisely that which the medical circumstances appear to me to justify.

When the question is, whether the injury resulted from accident or homicide, in relation to contused wounds, there are many difficulties which medical evidence, taken by itself, can seldom suffice to remove. A case was tried at the Warwick Spring Assizes in 1808, which not only in this, but in some other points of view, is of great medico-legal importance. In this instance, the deceased was found dead in a stable, not far from a vicious mare, and the traces of this animal were upon his arms and shoulders. The brother of the deceased was tried on the charge of having killed him with a spade, which was found lying in the stable. This spade was stained with blood; but the evidence from this fact was wholly set aside by the circumstance, that the spade had been subsequently used in cleaning out the stable. In the defence, it was alleged, that the deceased had been kicked by the mare while attempting to put on the traces, and had thus been accidentally killed. According to the medical evidence, there were two straight incised (?) wounds, apparently caused by a blunt instrument, on the left side of the head, one about five, and the other about two inches long. On the right side of the head there were three irregular wounds of a mixed lacerated and incised character, two of them about four inches in length. There was also a wound on the back part of the head, about two inches and a half long. There was no tumefaction round any of the wounds, the integuments adhering firmly to the bone. The right side of the skull was generally fractured,—the fracture extending along the back of the head to the left side,—a small portion of the temporal bone having come away. The deceased was found with his hat on, which was bruised, but not cut; and there were no wounds on any other part of his body. Two medical witnesses expressed a strong opinion, that the injuries could not have been produced by kicks from a horse, grounding that opinion principally on the distinctness of the wounds—the absence of marks of contusion,—the firm adherence to the integuments and the straight lateral direction and similarity of the wounds. They also thought that they could not have been inflicted without cutting the hat, if this had been on the deceased's head at the time; and if the hat had been off, that he could not have had the power to put it on after receiving the wounds. The case was not made out against the prisoner, and he was acquitted. (Will's Circ. Evidence, 302.) Taking the facts as they are here reported, there seems to be no good medical reason for assuming that the wounds on the head were homicidally inflicted. The fact that they had a somewhat incised character, is not a positive proof that the spade was used in producing them; since an instance has occurred where the skin of the scalp presented a similar incised appearance from the kick of a horse; and I believe it will not be found to be a very unusual consequence of a severe and sudden blow on those parts of the body where the skin is stretched over round surfaces of bone. In this case, another question arose, namely, whether wounds of this description could be inflicted on the head without cutting the hat. Admitting it to be improbable, that the deceased placed the hat on his head after being thus wounded, we must infer that it was on his head at the time, and admitting that the injury was produced by the bruising violence of a horse's hoof, it is easy to

understand that the scalp might be wounded without causing more than an indentation in the hat. Had the spade been used, it is less likely that the hat would have escaped. Hence the witnesses who assumed that the deceased had been killed by the spade, were obliged to suppose that the hat must have been off and put on afterwards, therefore that there must have been murderous interference. This, however, would not explain the fact, that the hat was indented over the situation of the principal injury. On the whole, this seems to have been really a case of accidental death.

It is of some importance as a medico-legal fact, that the skin may be wounded through the dress, without the latter being necessarily cut or torn. Mr. Baron Wood, who tried the above case, stated at the time that he remembered a trial at the Old Bailey, where it had been proved that a cut and a fracture had been received without having cut the hat of the wounded person; and evidence was then adduced of the infliction of a similar wound without cutting the hat. The question whether a wound was or was not self-inflicted, may refer to the *living* as well as to the dead. Thus a man may produce wounds upon himself for the purpose of simulating a homicidal assault, which, for various motives, he may allege to have been committed upon him. With the motives for the self-infliction of wounds a medical jurist is not concerned, it is of the fact only that he can take cognizance:—from the cases that have yet occurred, it would appear that the object has been to conceal murder, robbery, or some other crime, and to turn away suspicion from the wounded party. One of the most remarkable cases of this kind which has occurred in England was that of *Bolam*, who was tried for the murder of a man named Millie at the Newcastle Autumn Assizes, 1839.

It is impossible to enter into all the particulars of this singular trial; but it may suffice to state, that the prisoner Bolam was found lying in an apartment, which had been fired by himself or some incendiary, and near him was the body of the deceased, who had evidently been killed by violence,—the skull having been extensively fractured by a poker lying near. The prisoner was, when found, either insensible or he pretended to be so. He stated that he had been suddenly attacked by a man, and knocked down by a blow on the right temple. After attempting to escape, he was again knocked down. He then felt a knife at his throat, but admitted that he did not put up his hands to protect it. His hands were not cut. He said he remembered receiving some blows on his body, but he became insensible, and recollected nothing more. On examining his throat, there was a wound an inch and a half in length on the left side of the neck, a quarter of an inch below the jaw. It had penetrated merely through the true skin, and was of no consequence. A small quantity of blood, which had flowed down on the inside of his cravat, had escaped from this. There were many cuts on his coat at the back and sides, through his waistcoat, shirt and flannel shirt; but there were no corresponding cuts or stabs, nor indeed any mark of injury upon the skin. The question was, whether these wounds had been inflicted by the unknown person who was alleged to have fired the premises and murdered the deceased, or whether the prisoner had inflicted them on himself, in order to divert attention and conceal the crime which he was accused of having committed. No motive for the imputed crime was discovered, and he had borne a very good character; but nevertheless the medical facts relative to the probable self-infliction of the wounds were so strong, that he was convicted of manslaughter. There can hardly be a medical doubt that the prisoner produced

the wounds upon himself. They were superficial, involved no important organs, and bore the characters which those wounds only would have, that had not been produced with a suicidal intention.

It is not always easy to trace out the motive for the production of these injuries, and when a reasonable motive is not immediately discovered, persons are very apt to be misled and to credit the story. Individuals who have been convicted of thus imputing violence to others, have generally borne a highly respectable character until the occurrence, and this has contributed to disarm suspicion. When a person intending to commit suicide fails in the attempt, he has sometimes, under a sense of shame, attributed the infliction of a wound in his throat to another, but facts of this kind may be without difficulty cleared up by circumstantial evidence. In respect to *imputed* wounds, if we except the case of an attempt at suicide, where the injury is commonly severe, they are generally of a superficial character,—consisting of cuts or incisions:—deep stabs are seldom resorted to where the purpose is not suicide but merely to conceal other crimes. Further, these wounds are in front of the person and on the right or left side according to whether the person be right or left-handed. They have also been generally numerous and scattered wide apart. The hands are seldom wounded, although in the resistance to real homicidal attempts, it is these parts which commonly suffer most severely. The injuries are not usually situated over those parts of the body in which wounds are by common repute considered mortal, and there is usually an entire want of correspondence between the situation of the wounds on the person and the cuts or other marks on the dress. Contusions or contused wounds are seldom inflicted by a person on himself under these circumstances. A remarkable case, in reference to this question, occurred in France some years since. I allude to that of *M. Tardif* (Ann. D'Hyg. 1833, 417.) No motive could here be discovered for the self-infliction of wounds, and there was great room for suspicion. Breschet considered that they had been inflicted by another in a homicidal attempt. For cases of imputed wounds,—see Ann. D'Hyg. 1829, i. 257, here an examination of the weapon led to detection; also Ann. 1834, i. 179, and 1843, ii. 364.

CHAPTER XXIX.

WAS THE WOUND THE DIRECT CAUSE OF DEATH?

It is important for a medical witness to bear in mind that in all cases of wounds criminally inflicted, the cause of death must be *certain*. No man is ever convicted upon mere medical probability. In general,

there is only one real cause of death, although other circumstances may have assisted in bringing about a fatal result. Thus a person cannot die of disease in the bowels, or a stab in the chest at the same time, nor of apoplexy from disease, and compression of the spinal marrow at the same instant. Hence it is our duty when several apparent causes for death exist, to determine which was the *real* cause; and in stating it to the Court, to be prepared to offer our reasons for this opinion. In most cases of local injury, when a person dies speedily, there will be no great trouble in settling whether disease or the injury was the cause. A difficulty will, however, commonly exist when a person has recovered from the first effects of a wound, and has subsequently died. Besides, there may be cases in which the cause of death, in spite of the most careful deliberation, will be still obscure; or sometimes it happens that the death of a party appears to be as much dependent on bodily disease as on an injury proved to have been received at the time he was labouring under disease. How is an opinion to be expressed in such a case? The course which I apprehend a medical witness ought to pursue, provided he has duly deliberated on the circumstances before he appears in Court, and his mind is equally balanced between the two causes, is to state at once his doubt to the jury without circumlocution, and not allow it to be extracted from him in cross-examination. It is the hesitating to assign a satisfactory cause, or the assigning of many causes for death, that gives such advantage to a prisoner's case, even when the general evidence is entirely against him. Occasionally many causes of death are assigned by a witness, among which some have a tendency to exculpate and others to inculpate the prisoner in a greater or less degree, and it is left to the jury to select from the number, one upon which to found a verdict! In a case of this kind an acquittal is commonly obtained. A witness cannot do greater mischief to his own reputation than by assigning many speculative causes for death. The Court will at once infer, either that he is ill-informed in his profession, or that he has taken no pains to estimate in his own mind what was the real cause previously to his appearance at the trial. By preliminary reflection it is very easy for a medical witness to guard against the common occurrence of stating one cause of death to the counsel for the prosecution, and another to the counsel for the prisoner.

A wound may cause death either *directly* or *indirectly*. A wound operates as a *direct cause of death* when the person dies immediately, or very soon after its infliction; and there is no other cause, internally or externally, to account for death. In wounds which cause death *indirectly*, it is assumed that the deceased survives for a certain period, and that the wound is followed by inflammation, suppuration, gangrene, tetanus, erysipelas, or some other mortal disease, which is a direct and not an unusual consequence of the injury. Under this head may be also arranged all those cases which prove fatal by reason of surgical operations rendered imperatively necessary for the treatment of the injury,—presuming that these operations have been performed

with ordinary skill and care. We shall for the present consider only the direct causes of death in cases of wounds. These are three in number. 1. Hæmorrhage. 2. Great mechanical injury done to an organ important to life. 3. Shock, or concussion, whereby the functions of one or more vital organs are arrested, sometimes with but very slight injury to the part struck or wounded. From either of these causes a wounded person may die either immediately, or within a very few minutes.

1. Hæmorrhage.—Loss of blood operates by producing fatal syncope. A quantity of blood, however, insufficient to cause syncope, may readily destroy life by disturbing the functions of the organ or part into which it is effused. Thus a small quantity poured out in or upon the substance of the brain, may kill by inducing fatal compression;—and again, if in a case of wounded throat it should flow into the trachea, it may cause death by asphyxia, i. e. by stopping the respiratory process. In both of these cases it is obvious that the blood acts mechanically, and in respect to the last, a medical man may, unless circumspection be used, involve himself in a charge of malapraxis. If he allows the wound to remain open, the wounded person may die through hæmorrhage.—if he closes it too soon, he may die through suffocation; and, in either case, the counsel for the prisoner will not fail to take advantage of a plausible objection of this kind. In wounds of the chest, involving the heart and lungs, death is very frequently due not so much to the actual quantity of blood effused, as to the pressure which it produces upon these organs. A few ounces effused in the bag of the pericardium, will entirely arrest the action of the heart.

The absolute quantity of blood required to be lost in order to prove fatal must, of course, vary according to numerous circumstances. The young, the aged—those who are labouring under infirmity or disease, will perish sooner from hæmorrhage, than those who are healthy and vigorous. Females, cæteris paribus, are more speedily destroyed by hæmorrhage than males. Young infants are liable to die from hæmorrhage resulting from very slight wounds. An infant has been known to bleed to death from the bite of a single leech or from lancing the gums. The healthy and vigorous, when their vital powers have been depressed by maltreatment or by brutal violence, will sink under the loss of a comparatively small quantity of blood. (See Watson on Homicide, p. 90.) A medical jurist must not forget that some individuals have what is termed a hæmorrhagic diathesis, and this condition is often hereditary. The slightest wound or puncture,—the bite of a leech or the extraction of a tooth will be attended with an effusion of blood which cannot be arrested, and which will slowly lead to death by exhaustion. Cases have been frequently recorded in our medical journals, of fatal hæmorrhage following the extraction of teeth, where there had been previously nothing to indicate the probable occurrence of death from so trivial a cause. For a striking instance of this remarkable tendency to hæmorrhage in a family, see Brit. and For. Med. Rev. xvii. 247; also Med. Gaz. May, 1842. Such cases are without difficulty de-

tected :—since a surgeon may always infer from the part injured, and the extent of the injury, whether the hæmorrhage is likely to be copious or not. When a person bleeds to death from what would, under common circumstances, be a simple wound,—the admission of this fact may lessen the responsibility of an accused party.

A *sudden loss* of blood has a much more serious influence than the same quantity lost slowly. A person may fall into a mortal syncope from a quantity of blood lost in a few seconds, which he would have been able to bear without sinking, had it escaped slowly. This is the reason why the wound of an artery, proves so much more rapidly fatal than that of a vein. Death speedily follows the wound of a large artery like the carotid ; but it takes place with equal certainty, although more slowly, from wounds of smaller arteries. In a case where one of the intercostal arteries was wounded by a small shot, hæmorrhage caused death in thirty-eight hours. The hæmorrhage which follows the division of the smaller branches of the external carotid is often sufficient to destroy life unless timely assistance be rendered. A case was tried at the Berkshire Spring Assizes, 1832, in which it was proved that the prisoner had killed his wife by stabbing her in the leg ;—the anterior tibial artery was divided, and she died from hæmorrhage half an hour afterwards. Wounds of arteries, even smaller than these, might in some subjects prove fatal if no assistance were at hand. Mr. Watson mentions a case where the internal mammary artery on the left side, was divided by a stab in the chest. The woman died on the ninth day, and four pounds of blood were found effused on that side. In another case where an intercostal artery was divided, six pounds of blood were effused. (Op. cit. 101.) In both of these cases, as in most wounds of the chest, the blood not only affected the system by its loss, but by its compressing the lungs and impeding respiration. Wounds of large veins, such as the jugular, may speedily destroy life. If a wound be in a very vascular part, although no vessel of any importance be divided, the person may speedily die from hæmorrhage. It is difficult to say what quantity of blood should be lost, in order that a wound may prove fatal by hæmorrhage. The whole quantity contained in the body is calculated at about one-fifth of its weight, i. e. about thirty pounds :—of this one-fourth is considered to be arterial and the remaining three-fourths venous blood. According to Mr. Watson, the loss of from five to eight pounds is sufficient to prove fatal in adults :—but while this may be near the truth, many persons willdie from a much smaller quantity ; the rapidity with which the effusion takes place having considerable influence. It has been found, by experiment, that a dog cannot bear the loss of more blood, than is equivalent to one-twelfth part of the weight of its body.

It must not be supposed that all the blood met with round a wounded dead body, was actually effused during life. As soon as the heart's action ceases, the arteries pour out no more ; but the blood, so long as it remains liquid, and the warmth of the body is retained,

continues to drain from the divided veins and smaller vessels. The quantity thus lost, however, is not very considerable, unless the veins be large. A question relative to the degree of this post-mortem hæmorrhage has very frequently been put in a Court of law. Hæmorrhage may prove fatal, although the blood does not escape from the body. In incised wounds, the flow is commonly abundant; but in punctured and gun-shot wounds, the effusion may take place internally and rapidly cause death. In severe contusions or contused wounds, the effusion may go on to an extent to prove fatal, either in the cavities of the body or throughout the cellular membrane. Many pounds may in this way become slowly or rapidly extravasated. The means of ascertaining, whether a person has died from hæmorrhage, are these. Unless the wound be situated in a very vascular part, we shall find the vessel or vessels from which the blood has issued, divided,—the neighbouring vessels empty, and the body more or less pallid; although this last condition is of course liable to be met with in certain cases of disease, as also under copious venesection,—points easily determined by an examination. The blood will also be found clotted or coagulated on those surfaces on which it has fallen. If, with these signs, there is an absence of disease, likely to prove rapidly fatal, and no other probable cause of death be apparent, it may be fairly referred to hæmorrhage. This opinion may be materially modified by the fact of the body not being seen on the spot where the fatal wound was actually inflicted,—by the wound having been sponged,—the blood removed by washing, and all traces of hæmorrhage destroyed. Under these circumstances, the case must be in a great measure made out by presumptive proof; and here a medical witness may have a new duty thrown upon him, namely, that of examining articles of dress or furniture for marks or stains of blood.

Hæmorrhage may in some instances take place from a wound in a *dead* body after the vital heat has entirely disappeared,—a fact which in former times, gave rise to the most superstitious notions, and which even in the present day, sometimes induces a coroner's jury wrongly to suspect that homicide has been committed. In order to explain this and some other vital phenomena connected with the dead body, it is necessary to refer to those spontaneous changes in the solids and liquids which commence soon after death. When a person has died suddenly from violence or disease, it often happens that within a short period, the whole of the cavities, including the veins, arteries, and cellular tissue, become distended from the gases extricated by incipient putrefaction. These gases, when they collect in the abdomen, push back the diaphragm, in consequence of which, mucus in the state of froth often issues from the mouth and nostrils: the face becomes swollen, the eyes bright and prominent, owing to the blood being forced back to the head and neck. From the same cause, it sometimes happens that the contents of the stomach are actually discharged, escaping into the trachea or externally by the mouth. These gases appear also to be formed within the heart and blood-vessels, a circumstance which

leads to the effusion of blood from a wound made into a vessel before death, long after life has ceased. If an attempt has been made to bleed a person before death, and the operator has neglected to secure the opening in the vein, a large quantity of blood will sometimes thus escape, giving to those who are unacquainted with the cause, the impression that the deceased had again come to life, but had died from the bleeding. An accident of this kind gave rise to considerable discussion on the occasion of an inquest held at Oldham, on the body of one John Lees, killed in the Manchester riots in 1819, as also in the case of the Crown Prince of Sweden, who was suspected to have been poisoned, (ante, p. 25.) A similar flow of blood may take place from any large incised wound, involving a vein, made recently before death. This post-mortem hæmorrhage is facilitated by pressure; and hence probably arose the ancient test of the guilt of an accused party, namely, the touch of a murderer.

Chemical examination of blood stains.—It might appear at first sight a very easy matter to say whether certain suspected spots or stains on articles of clothing, furniture or weapons, were or were not due to blood; but in practice, great difficulty is often experienced in forming an opinion. If the stains be recent, most persons might be competent to form an opinion; but the physical characters of blood are soon changed, even when the stuff is white and otherwise favourable to an examination. Again, when the stains, whether recent or of old standing, are upon dark-dyed woollen stuffs, as blue or black cloth, or when they appear in the form of spots or thin films on a rusty weapon, no one but a professional man should be allowed to give an opinion. It is, however, by no means unusual to find magistrates and coroners, questioning policemen respecting the nature of suspected stains,—a practice obviously unjust to the accused and fraught with considerable danger. There is no direct chemical process by which blood can be identified, but we presumptively establish its nature by determining the presence and properties of the red colouring matter or hæmatosine. The microscope has not, I believe, been much employed in these medico-legal investigations. The chemical properties of the red colouring matter are as follows:—

1. The colouring matter of blood readily combines with distilled water, forming, if recent, a rich red solution. 2. The red colour of this solution is neither turned of a crimson nor of a green colour by a solution of ammonia: if the ammonia be very concentrated, the red liquid acquires a brownish tint. 3. The red liquid when boiled is coagulated,—the red colour is entirely destroyed, and a muddy brown flocculent precipitate is formed,—the quantity of which will depend on the quantity of colouring matter and albumen present. 4. The coagulum produced by boiling, when collected on a filter and dried, forms a black resinous-looking mass quite insoluble in water, but readily soluble in boiling caustic potash, forming a green coloured solution. 5. To the above tests some have united the action of strong nitric acid, which coagulates the red colouring matter, turning it of a dirty brown hue. M. Boutigny has suggested another plan for making this solution, by taking advantage of the repulsion (for liquids) in red-hot metals. (Ann. D'Hyg. 1844, ii. 217.) It will now be proper to mention the action of these tests upon other red colouring matters, extracted from the animal or vegetable kingdom. Some of these are turned green by ammonia, as the colouring matter of the rose,—others crimson, as the red colouring matter of cochineal and of lac. None of these red colours are coagulated or destroyed by boiling. In these respects, therefore, the colouring matter of the blood is eminently distinguished from them. M. Raspail has objected that a mixture of madder and albumen possesses all the characters assigned to blood. Having for some years past performed numerous experiments on this subject, by making

artificial mixtures of human serum or animal albumen, with the red colouring matters of cochineal, lac, and madder, and neutralizing the effects of the alkali contained in the serum by the addition of a small quantity of acetic acid,—I feel justified in stating that in no respect whatever except in regard to colour, can such mixtures be confounded with blood. The objection is therefore more theoretical than practical. These red liquids may easily deceive those who trust to a *red colour* alone; and herein we see the absolute necessity for placing the investigation of such subjects in the hands of professional persons only. It may be observed of all such artificial mixtures, that by ammonia they are changed to a crimson or green tint, and that under no circumstances, is the red colour destroyed by boiling the solution in water. The albumen of serum, if in sufficient quantity, coagulates, but still retains the red colouring matter locked up within the coagulum. In the case of blood, the effect of heat is widely different.

Stains of blood on linen and other stuffs.—Supposing the stuff to be white or nearly colourless, the spot is of a deep red colour if recent:—but it becomes of a reddish brown, or of a deep brown, by keeping. The change of colour to a reddish brown I have found to take place in warm weather in less than twenty-four hours. After a period of five or six days, it is scarcely possible to determine the date of the stain even conjecturally. In a large stain of blood on linen no change took place during a period of five years:—it had a brown colour at the end of six weeks, which it retained for the long period mentioned. Indeed it is extremely difficult in any case after the lapse of a week, to give an opinion as to the actual date of a stain. Upon coloured stuffs it is of course, impossible to trace these physical changes in stains of blood,—on red dyed stuffs the stain of blood appears simply darker from the first, and in all cases the fibre of the stuff is more or less stiffened. Attention should be paid to the side of the stuff, if an article of dress, which has first received the stain:—sometimes both sides (if it be an apron or a stocking) are stained. Important evidence may be derived from an observation of this kind. In order to determine whether the stain be due to blood, we cut a slip of the stained part of the linen and suspend it by a thread in a small test-tube containing a small quantity of distilled water. After a few minutes, or a few seconds if the stain be recent, a red liquid will be seen falling in fine dark threads, and collecting at the bottom of the test-tube, giving a red colour to the lower stratum of water; and a dark red brown colour, if it be of old standing. The separation may not take place in less than an hour if the stuff be thick and coarse, or not readily pervious to water. When the stain is on silk it is speedily separated. Several slips of the stuff may be thus successively treated until a liquid, sufficiently deep in colour for testing, is procured. If the quantity of coloured liquid thus obtained be small, the supernatant clear water may be carefully poured off; but it is better to use a small tube and a small quantity of water. The liquid may then be tried by weak ammonia, and by the application of heat. If ammonia produce any effect upon the solution of blood, it is simply to brighten it,—this alkali never changes the red colour to *green* or *crimson*. When the stain is of old standing,—the solution in water does not present the bright red colour of blood, and the action of ammonia may be obscure, although it never gives to the liquid a green or crimson tint: but the action of heat is always certain and effectual; and if the coloured solution be in such small quantity that there is no coagulum obtained by heat, it is impossible to give a decided opinion that the stain is due to blood. In May, 1838, a piece of linen was examined on which there were two faint spots of blood, each about one quarter of an inch in diameter. A reddish coloured liquid was procured, but no coagulum could be obtained on boiling. When the quantity of blood effused is moderately large, it may be easily detected by the above process—even after the lapse of a great length of time. I have thus detected the blood of the human subject and of the bullock on cotton, linen, and flannel, after the lapse of *three years*. If the stuff be dyed, we should proceed to examine it in the same way. Thus then in testing for blood we rely upon,

1, the ready solubility of the hæmatosine in water; 2, the negative action of ammonia; and 3, the positive effect of heat in entirely coagulating and destroying the red colouring matter. It may, however, be objected, that red stains closely resembling blood are occasionally found on linen and other stuffs. It is to be remarked of all such stains, that they are either entirely insoluble in water or they are soluble. If insoluble they cannot by any possibility be mistaken for blood. It is very true, that if the linen which is stained with blood, be heated to a high temperature, the colouring matter may be no longer soluble in water:—but it is not probable that medical evidence will be thus defeated, except by those who have made a profound study of the difficulties of medical jurisprudence. In the case of a body found wounded and burnt, we may allow for such a change. If the blood-stain be covered with oil or grease, this will interfere with the action of water. If the stain be on a plaster wall or on wood, we must scrape or cut out a portion and digest it in a small quantity of water in a tube or watch-glass. It will be proper here to examine in the first instance an unstained portion of the plaster or wood.

Among what may be classed as *insoluble* stains, are, 1, certain *Red dyes*, as madder for instance, which when fixed by a mordant, is not readily affected by ammonia. 2. *Iron moulds*—these are of a reddish-brown colour, sometimes of a bright red,—they are quite insoluble in water, but are easily dissolved by diluted muriatic acid, and on adding ferrocyanate of potash to the muriatic solution, the presence of iron will be at once apparent. Care should be taken that the muriatic acid used for this purpose contains no iron. Some years since, a man was found drowned in the Seine, at Paris, under suspicious circumstances. The body had evidently lain a long time in the water. On examining the shirt of the deceased, a number of red-brown stains were observed upon the collar and body, resulting, as it was supposed, from blood which had become changed by time. On a chemical examination, however, they were found to be iron-moulds produced by the corrosion of a steel-chain which the deceased had worn round his neck! 3. *Red paint*—Stains made with red paint have been mistaken for blood. In March, 1840, a person was murdered at Islington. An individual was arrested on suspicion, and in his possession was found a sack, having upon it many red stains, which were supposed to be dried and coagulated blood. They were examined by Professor Graham, who found that they were caused by red paint, containing peroxide of iron, and the sack was proved to have been worn as an apron by a youth who was an apprentice to a paper-stainer. It had been sent to the accused party a few days before, as a wrapper to a parcel. The accused was immediately discharged. Stains of this kind would be known by digesting them in diluted muriatic acid, and applying to the solution, the tests for iron. Like those produced by iron-moulds, they are perfectly insoluble in water, and therefore cannot be confounded with blood-stains. The same may be said of spots of the ammonio-nitrate of silver, which I have known to be mistaken for old stains of blood. The stuff on which the spots of blood are found, may be itself stained with a red dye or colour,—in this case it will be necessary to test by the same process a piece of the coloured or stained portion, in order to furnish negative evidence that the suspected stains are due to blood. Among the *soluble* stains resembling those of blood are the spots produced by the juices of the mulberry, currant, and other red fruits. These are commonly recognized by dropping on them a solution of ammonia, when the spot is turned either of a green or crimson colour. This crimson colour in very diluted solutions is sometimes only *slowly* developed on the addition of ammonia or potash. A spot of blood thus treated undergoes no change. Further, if a piece of the stained stuff be suspended in water, the coloured liquid, if any be obtained, is easily known from blood, by its acquiring a green or crimson tint on the addition of ammonia, and, by the red colour not being coagulated or destroyed when the liquid is boiled. In some red stuffs, the dye is often so bad, that water will dissolve out a portion of the colour; but in this case the action of ammonia and heat will serve readily to distinguish the stains from

blood. If minute spots be scattered on articles of furniture, these may be examined by cutting out the stained portions and treating them in the way just mentioned. It is said that blood-stains, when minute and scattered, are more readily recognised and identified by the light of a candle than in the light of day. I do not know that much reliance can be placed on this statement. The brown stains appear to acquire a redder tint.

It is not unfrequent that an attempt is made by a murderer to wash out blood-stains, so that the colour is lost and no chemical evidence can be obtained. There is a common notion that certain chemical agents will remove or destroy these stains; but this is not the case,—the colour may be altered but it is not discharged or bleached. Chlorine, a most powerful decolorizing agent, turns the colouring matter of blood of a green-brown colour. Hypochlorous acid has a similar effect. This acid has been lately recommended as useful by its bleaching properties for distinguishing the stain of blood from all other stains, except those produced by iron-rust. Orfila has, however, shown that it is not fitted for such a purpose, and that there are no better methods of testing than those above described. (Ann. D'Hyg., 1845, ii. 112.) I have found that nothing removes a blood-stain so effectually as simple maceration in cold water, although the process is sometimes slow. On an important trial for murder, at the Shrewsbury Lent Assizes, 1841, (the *Queen against Misters*,) this question as to the power of certain reagents in discharging stains of blood, was raised. Alum was traced to the possession of the prisoner; it was found dissolved in a vessel in his bed-room, and it was supposed that he had removed some blood-stains from his shirt by the use of this salt. Two medical witnesses deposed that they had made experiments and had found that alum would take the stains of blood out of linen:—according to one, sooner than soap and water. The results of my experiments do not correspond with these. I have not found that alum extracts stains of blood so readily as common water, and when alum is added to a solution of hæmatosine in water, so far from the colour being discharged, it is slowly converted to a deep greenish brown liquid. In one experiment, a slip of linen, having upon it a deep stain of dried blood of old standing, was left in a solution of alum for twenty-four hours, but not a particle of the red colouring matter had been extracted, although it was changed in colour. The prisoner's guilt did not rest on this point alone,—that was made sufficiently evident from other circumstances: but there have been few cases tried in England where the facts connected with the analysis of blood-stains were so closely examined, or of such great importance as in this. In a case to be presently related, I was consulted as to whether the alkali contained in yellow soap, would alter or remove blood-stains. The effect of potash, soda and their carbonates, is to change the red colour of blood to a deep greenish brown, like many other reagents,—but they do not exert on it any discharging or bleaching power. Combined with friction, blood-stains may be easily effaced by any cold alkaline or soapy liquid.

Stains of blood on weapons.—When recent, and on a polished instrument, they are easily recognized, but when of old standing, or on a rusty piece of metal, it is a matter of some difficulty to distinguish them from the stains produced by rust or other causes. If the stain of blood be large, a portion will readily peel off on drying. This may be placed in a watch-glass of distilled water, filtered to separate any oxide of iron and then tested. If the water do not acquire a red or red-brown colour, the stain is not due to blood. Sometimes on a dagger or knife, the stain appears in the form of a thin yellowish film, and is so superficial that it cannot be mechanically detached. We should then pour a stratum of water on a piece of plate-glass, and lay the stained part of the weapon upon the surface. The water slowly dissolves any portion of the colouring matter of blood, and this may be examined in the way recommended. If the weapon have been exposed to heat, this mode of testing will fail. There is often a remarkable resemblance to the stains of blood on metal produced by the *oxide or certain vegetable salts of iron*. If the juice of lemon or orange be spread upon a steel blade, and remain exposed to air for a few days, the resemblance to blood produced by the formation of

citrate of iron is so strong, that I have known well-informed surgeons to be deceived:—they have pronounced the spurious stain to be blood, while the real blood-stain on a similar weapon, was pronounced to be artificial. This difficulty of distinguishing such stains by the eye, is well illustrated by a case which occurred in Paris a few years since. A man was accused of having murdered his uncle, to whose property he was heir. A knife was found in his possession, having upon it dark-coloured stains, pronounced by those who saw them, to be stains of blood. M. Barruel and another medical jurist were required to determine the nature of these stains, and the examination was made before a magistrate in the presence of the accused. They were clearly proved by these and other experiments, to be spots produced by the citrate of iron. It appeared on inquiry, that the knife had been used by some person a short time previously, for the purpose of cutting a lemon; and not having been wiped before it was put aside, a simple chemical action had gone on between the acid and the metal, which had given rise to the appearance. This case certainly shows, that physical characters alone cannot be trusted to in the examination of these suspected stains. Stains of the *citrate of iron* may be thus known. The substance is soluble in water, forming, when filtered, a yellowish brown solution, totally different from the red colour of blood under the same circumstances. The solution undergoes no change on the addition of ammonia. It is entirely unchanged at a boiling temperature: and it is at once identified as a salt of iron, by giving a blue colour to the ferrocyanate and a deep red with sulphocyanate of potash. I have also observed, that spots of the citrate of iron on knives, for they are not found on other weapons, are often soft and deliquescent, while those of blood are commonly dry and brittle.

It might be supposed to be a very simple matter to distinguish by sight, a stain of blood on a weapon from a mark produced by *iron-rust;* but this is not the case. When suspicion exists, it is astonishing how readily mistakes are made; and marks are pronounced to be due to blood, which, under other circumstances, would have passed unnoticed. One source of difficulty is this: the iron-rust is often mixed up with articles of food on an old knife, or even with blood itself. We must here pursue the same mode of examination, as if the stain were of blood; we macerate the weapon or a portion of the coloured deposit in a small quantity of distilled water, and filter the liquid. If the stain be due to iron-rust, this is separated by filtration, and the liquid comes through colourless. The absence of blood is thereby demonstrated; for I need not here consider the objection, that the weapon may have been exposed to heat, and thus have rendered the blood-stain insoluble in water. If we now digest the brown undissolved residue left on the filter, in diluted muriatic acid free from iron, we shall obtain a yellowish solution, which will give the proper reactions for iron, with the ferrocyanate and sulphocyanate of potash. It has been recommended, to put muriatic acid on the stain as it exists on the weapon, and then to test the liquid, as the red spot of rust is soon removed by the acid; but the objection to this is, that a spot containing blood, may be thereby pronounced to be one of rust only, since muriatic acid in all cases, dissolves a portion of the iron, and the solution would therefore give the characters of an iron-stain with the tests. In all old blood-stains where the weapon is rusty, blood and oxide of iron are mixed. These may be easily separated by digesting the compound in water and filtering,—the blood only is dissolved, while the rust is left on the filter.

The following case was referred to me for examination a few years since. A man was suspected of murder, and some stains existed on his shirt, which were supposed to have been produced by blood. Around the collar and upper part of the shirt, there was a large and somewhat deep pinkish-red stain, in some respects resembling washed blood. This I considered as a very unusual situation for blood to be found sprinkled; and upon trying the stained linen by the processes mentioned, the colour entirely resisted separation by water, and was turned of a slight crimson tint by ammonia. The stain was thus shown not to be due to blood. On inquiry, it was ascertained, that the man had worn

round his neck, a common red handkerchief during a wet night, and while taking violent exercise! The stain was thus accounted for. There were, however, some other marks on the shirt which required examination, as there was a very strong suspicion against this man. These were on the sleeves, at those parts which would be likely to receive stains of blood if they had been rolled or turned up at the wrists; and it was clearly ascertained, that the murderer in this case, had washed his hands, using a quantity of yellow soap. These stains were of a brownish colour, without any shade of red; they were faint in parts and diffused, conveying the impression that an attempt had been made to wash them out. So far as external characters were concerned, it was quite impossible to say whether they had been produced by blood or not. On examining those parts of the shirt, corresponding to the axillæ, stains precisely similar were there seen, evidently resulting from cutaneous perspiration; since the suspicion of blood being poured out on this part of the shirt under the circumstances, could not be entertained. Slips of linen from the stained portions of the sleeves were digested in water. In twenty-four hours, the stains were entirely removed; and the lower stratum of water in each tube, had acquired a straw-yellow colour. There was not the least shade of a red or brown tint; and the solution was wholly unlike that produced by blood under any circumstances. The solution was unaffected by ammonia, as well as by a heat of 212°; but it gave a faint opalescence on the addition of nitric acid. These results not only indicated the absence of blood, but showed that the stains were due to cutaneous perspiration, acting on a dirty skin, and through a dirty dress. The stains on the part corresponding to the axillæ could not be ascribed to blood; and from the similarity in physical and chemical properties, it was impossible to attribute those on the sleeves to any sanguineous effusion. It so happened, however, that a large pocket-knife, with numerous dark-red stains on the blade and between the layers of the handle, was found upon this man, and this was also sent for examination. Several persons who saw the knife, pronounced a strong opinion that the marks were due to blood. The stains were made up of some soft viscid matter which gave out ammonia when heated, and left a residue of peroxide of iron. On digesting the matter in water, no portion was dissolved; and it was, therefore, evident that they were due not to blood, but to a mixture of some animal matter, probably food, with iron-rust. These results were somewhat in the man's favour, at least they removed what was considered to be a strong circumstantial proof of his guilt. He was subsequently tried for the murder, and acquitted on an alibi, established by the evidence for the prosecution.

From the foregoing remarks, we may justly infer, that the analysis of suspected spots or stains on weapons and clothing, is by no means a trivial or unimportant duty. If we cannot always obtain from these experiments affirmative evidence, they often furnish good negative proofs, and thus tend to remove unjust suspicions against accused parties. There is one circumstance, however, of which a medical jurist is entitled to complain, namely, that a magistrate or coroner should ever receive evidence on matters of this kind from non-professional persons, or that they should ever trust to physical characters only. On the occasion of the murder of *Eliza Grimwood*, in June 1838, committed as it was under circumstances of the greatest mystery, and the perpetrator of which has not yet been discovered, the analysis of suspected marks resembling blood, became rather an important part of the inquiry, but it was most improperly conducted. The finger-plates of the door of the room, in which the murder was perpetrated, presented some dark stains, supposed to have been produced by the bloody hand of the murderer in the act of escaping. The only test to which these were submitted, was, that the magistrate before whom the case was heard, tried to rub off some of the stains with a piece of blotting paper, but did not succeed; and he expressed his opinion, that if they were blood-stains they had been wiped! It is easy to perceive, to what evil results, superficial examinations of this kind may lead. When marks of blood undeniably exist on the dress of an

accused person, it is by no means unusual to find these marks referred to his having been engaged in killing a pig or a sheep, or handling fish or dead game. Of course, every allowance must be made for a statement like this, which can only be proved or disproved by circumstances. A question here arises, whether we possess any chemical means of distinguishing the blood of a human being from that of an animal, as well as the blood of a man from that of a woman. See on this subject Ann. D'Hyg. 1829. 267, 548.—1830, 433, 1831, 467. 1833, 226, ii. 160. 1834, 205. 1835, ii. 349. 1839, i. 219. 1840, i. 387. also Henke Zeitschrift, der S. A. 1844, ii. 273.

Some French medical jurists state, that by mixing fresh blood with one-third or one-half of its bulk of strong sulphuric acid, and agitating the mixture with a glass rod, a peculiar odour is evolved, which differs in the blood of man and animals, and also in the blood of the two sexes. This odour, it is said, resembles that of the cutaneous exhalation of the animal, the blood of which is made the subject of experiment. They have hereby pretended to determine, whether any given specimen of blood belonged to a man, a woman, a horse, sheep, or fish. Others assert that they have been able to identify the blood of frogs and fleas! (See Devergie, Med. Leg. ii. 907.) Now it is certain, that an excess of strong sulphuric acid, does give rise to a particular odour in blood, probably owing to its decomposing some of the animal principles of that liquid; it is also possible that some persons may discover a difference in the odour, if not according to the sex, at least according to the animal, but even this point is far from being established; and if it were admitted, there is probably not one individual among a thousand, whose sense of smelling would be so acute as to allow him to state with undeniable certainty, from what animal the unknown blood had really been taken. Any evidence short of this, would not be received in an English Court of law; for it is considered better not to decide at all, than to decide on principles which are exposed to unavoidable fallacy. Besides, it must be remembered, that in general the operator has not before him the blood, but merely a very diluted solution of the colouring matter mixed with a small quantity of serum.

II. Great Mechanical injury done to an organ important to life.—We have instances of this becoming a direct cause of death in the crushing of the heart, lungs or brain, by any heavy body passing over or falling on the cavities. This severe mechanical injury is sometimes accompanied by a considerable effusion of blood, so that the person really dies from hæmorrhage; but in other instances the quantity of blood lost is inconsiderable, and the fatal effect may be referred to shock.

III. Shock.—This is a direct cause of death under the infliction of external violence; and in this case life is destroyed without the injury being to all appearance sufficient to account for so speedily fatal a result. There is no medical doubt that a person may die from what is termed shock, without there being any marks of severe injury discoverable after death. Examples of this mode of death we have in accidents from lightning, or from severe burns or scalds, in which the local injury is often far from sufficient to explain the rapidly mortal consequences. As instances of this form of death from violence, may be cited, those cases in which a person has been suddenly killed by a blow on the epigastrium, which is supposed to operate by producing a fatal impression on the cardiac plexus. Whether this be or be not the true explanation, the fact itself is undisputed; it is certain that a person may die from so simple a cause without there being any appearance

externally or internally to account for death. On the skin, there may be some marks of abrasion or ecchymosis, but as it has been elsewhere stated, these are neither constant nor necessary accompaniments of a blow. Convictions for manslaughter have taken place, where death has been produced under these circumstances. Concussion of the brain, unattended by mechanical lesion, is another example of this kind of death. A man receives a severe blow on the head; he falls dead on the spot, or becomes senseless and dies in a few hours. On an inspection, there may be merely the mark of a bruise on the scalp; in the brain, there may be no rupture of vessels or laceration of structure, and all the organs of the body are found healthy. Thus, then, there may be no sign of a mortal injury: and there is apparently no cause to account for death. This can only be referred to the shock or violent impression which the nervous system has sustained from the blow,—an impression which the vital powers were wholly unable to counteract or resist. A medical witness must give his evidence with caution in such cases; since it is the custom to rely in the defence upon the absence of any *mortal* wound to account for death,—a principle which if once unrestrictedly admitted as correct, would leave a large number of deaths, undoubtedly occurring from violence, wholly unexplained. A trial took place at the Liverpool Autumn Assizes, 1837, wherein several persons were charged with the manslaughter of the deceased, by kicking him behind the right ear. The medical witness deposed that there was in this spot the mark of a severe contusion, but there was no injury whatever to the brain, and the body was otherwise healthy. He very properly ascribed death to the violent shock given to the nervous system, and the Court admitted that the cause of death was satisfactorily made out. The party who inflicted the wound was convicted.

There is another form of shock which is of some importance in medical jurisprudence. A person may have received *many injuries*, as by blows or stripes, not one of which, taken alone, could, in medical language be termed mortal; and yet he may die directly from the effects of the violence either on the spot or very soon afterwards. Death is commonly referred to exhaustion, but this is only another mode of expression; the exhaustion is itself dependent on a fatal influence or impression produced on the nervous system. A prize-fighter after having, during many rounds, sustained numerous blows on the body, may either at or after the fight, sink and die exhausted. His body may present marks of bruises, or even lacerated wounds, but there may be no internal changes to account for death. In common language, there is not a single injury which can be termed mortal, and yet supposing him to have had good health previously to the fight, and that all marks of disease indicative of sudden death are absent, it is impossible to do otherwise than refer his death to the direct effect of the violence. A case of a somewhat similar kind, we have in the military punishment of flagellation, which is occasionally followed by death. In short, it is a well ascertained medical fact, that a multiplicity of injuries, each comparatively slight, are assuredly as capable of

operating fatally as any single wound, whereby some organ important to life is directly affected. Age, sex, constitution, and the previous state of health or disease, may accelerate or retard the fatal consequences. On a trial for murder, which took place in Germany a few years since, it was proved that the deceased had been attacked with sticks, and that he had been afterwards flogged on the back with willow-switches. He died in about an hour. On inspection, there was no mortal wound nor any lesion to a vital organ; there were simply the marks of lacerations and bruises on the skin, apparently not sufficient to account for death, but this was nevertheless very properly referred to the violence. (Henke Zeitschrift der S. A. 1836.) From these considerations, it is obviously absurd to expect, that in every case of death from violence or maltreatment, there must be some specific and well-defined mortal lesion to account for that event. When the circumstances accompanying death are unknown, a medical opinion should always be expressed with caution; but if we are informed, that the deceased was in ordinary health and vigour previous to the infliction of the violence, and there is no morbid cause to account for his sudden illness and death, there is no reason why we should hesitate in referring death to the effects of a multiplicity of injuries. Among non-professional persons a strong prejudice exists that no person can die from violence unless there be some distinct *mortal* injury actually inflicted on his person. By this we are to understand a visible mechanical injury to some organ or blood-vessel important to life; but this is obviously a very erroneous notion, since death may take place from the disturbance of the functions of an organ without this being necessarily accompanied by a perceptible alteration of structure. The prevalence of this popular error, often leads to a severe cross-examination of medical witnesses. Among the questions put, we sometimes find the following:—Would you have said from the wounds or bruises *alone*, that they were likely to have occasioned death? Now in answer to this, it may be observed, that we cannot always judge of the probability of death ensuing from the appearance of external violence alone. But because these appearances were slight, it would be wrong to infer in every case that they were *not* sufficient to cause death. A man may die from a blow on the epigastrium, and how can this fact be determined by an examination of the body? Then it may be inquired, Were the wounds or bruises mortal? In the vulgar sense of the word, i. e. by producing severe hæmorrhage or a destruction of parts they might not be so; but in a professional view, they may have acted mortally by producing a shock to the nervous system. Or it may be inquired, which of the several wounds or bruises found on the body of the deceased, was mortal? The answer to which may be: Not one individually, but all contributed to occasion death by exhaustion.

It must likewise be remembered, that in all cases where a person has sustained a number of injuries, the loss of a much smaller quantity of blood than in other instances, will suffice to destroy life. It is sometimes a very difficult question to decide on the degree of mortality

of wounds, and on the share which they have had in causing death. By a wound being of itself *mortal,* we are to understand, that it is capable of causing death directly or indirectly, in spite of the best medical assistance. It is presumed that the body is healthy, and that no cause has intervened to bring about or even accelerate a fatal result. The circumstance of a person labouring under disease when wounded in a vital part, will not, of course, throw any doubt upon the fact of such a wound being necessarily mortal, and of its having caused death. If there shonld be more wounds than one, it is easy to say from the nature of the parts involved, which was likely to have led to a fatal result. In order to determine whether or not a wound was mortal on medical grounds, we may propose to ourselves this question : Would the deceased have been likely to die at the same time and under the same circumstances, had he not received the wound ? There can be no general rule for determining the mortal nature of wounds. Each case must be judged of by the circumstances which attend it. In some parts of the Continent, the law requires that a medical witness should draw a distinction between a wound which is absolutely and one which is conditionally mortal. An absolutely mortal wound is defined to be that where the best medical assistance being at hand, being sent for or actually rendered, the fatal event could not be averted. Wounds of the heart, aorta, and internal carotid, are of this nature. A conditionally mortal wound is one, where, had medical assistance been at hand, been sent for or timely rendered, the patient would, in all probability, have recovered. Wounds of the brachial, radial, and ulnar arteries, may be taken as instances. The responsibility of the assailant is made to vary, according to which of these classes, the wound may be referred by the medical witnesses, and, as it is easy to suppose, there is seldom any agreement on the subject. Our criminal law is entirely free from such subtleties. The *effect* of the wound and the *intent* with which it was inflicted, are looked to : its anatomical relations, which must depend on pure accident, are never interpreted in the prisoner's favour. Some extenuation might be admitted when a wound proves mortal through an indirect cause, as inflammation or fever, and medical advice was obtainable, but not obtained until every hope of recovery has disappeared. Even here it ought to be shown, that it was within the power of the wounded person to obtain medical assistance, or such a defence could not be received in extenuation. It would appear however from the case of the *Queen* v. *Thomas* and others, (Gloucester Aut. Ass. 1841,) that the mere neglect to call in medical assistance is not allowed to be a mitigatory circumstance, in the event of death ensuing. The deceased died from the effects of a severe injury to the head inflicted by the prisoners, but had had no medical assistance. The judge said it was possible that " if he had had medical advice, he might not have died ; but whoever did a wrongful act must take the whole consequences of it. It never could make any difference, whether the party injured had or had not the means or the mind to apply for medical advice." The prisoners

were convicted. According to Lord Hale, if a man be wounded, and the wound, although not in itself mortal, turn to a gangrene or fever, for want of proper applications, or from neglect, and the man die of gangrene or fever, this is homicide in the aggressor, for though the fever or gangrene be the immediate cause of death, yet the wound being the cause of the gangrene or fever, is held the cause of death, *causa causati*. These nice questions relative to the shades of responsibility for personal injuries occasionally arise in those cases where a man has been wounded at sea on board of a ship in which there is no surgeon.

CHAPTER XXX.

DEATH MAY FOLLOW A WOUND, BUT NOT BE CAUSED BY IT.

This event is by no means uncommon, and, as in the minds of non-professional persons, death may appear to be a direct result of the injury, the case can only be cleared up by the assistance of a medical practitioner. In several instances of attempted suicide of recent occurrence, such a coincidence has been witnessed. A man has inflicted a severe wound on himself while labouring under disease; or some morbid change, tending to destroy life, has occurred subsequently to the infliction of a wound,—death has followed; but a surgeon, by careful examination of the body, has been able to refer death to the proper cause. The importance of an accurate discrimination in a case where a wound or personal injuries have been caused by another, must be obvious on the least reflection; a hasty opinion may involve an accused party in a charge of manslaughter; and, although a barrister might be able to show on the trial, that death was probably attributable, not to the wound, but to co-existing disease, yet it must be remembered, that the evidence of a surgeon before a coroner, in remote parts of this country, may be the means of causing the accused to remain incarcerated for a period of five, six or seven months previously to the trial. This is in itself a punishment, independently of the loss of character, to which an accused party must be, in the mean time, exposed. In September, 1832, an inquest was held on the body of a man who, it was supposed, had died from a wound in the throat, inflicted by himself while labouring under delirium from scarlet fever. On an examination of the body, it was found that but little blood had been lost, and none of the important vessels of the neck were injured. The jury and the friends of the deceased were prepared to hear that his death was caused by the wound; but they were undeceived by the surgeon, who attributed it to the effects of the disease under which he was labouring, adding, that there was every probability that he would have died at the same time, and under the same circumstances, if he

had not made the attempt on his life :—a verdict was returned accordingly. In the following case, a gentleman attempted to commit suicide, by cutting his throat with a pen-knife. He died in about three weeks afterwards, and an inquest was held on the body. From the medical evidence it appeared that the wound was situated on the right side of the neck,—it was four inches in depth, and one inch in length, and involved some of the branches of the subclavian artery. The case went on favourably, but secondary hæmorrhage occurred twice, in consequence of the deceased having violently torn away the dressings. After lying for about three weeks with a fair prospect of recovery, the deceased died suddenly,—a circumstance which led his medical attendants to conclude that some internal disease must have co-existed, although it was the general opinion that the wound had caused death. The body was carefully inspected, and a large abscess, occupying one of the hemispheres of the brain, was discovered, with an effusion of water between the membranes. These appearances, coupled with the symptoms immediately preceding, satisfactorily accounted for the fatal result. The medical witnesses accordingly deposed at the inquest, that death was occasioned by the abscess ; and that this had no connection whatever in its origin with the wound. They stated that the abscess had probably been forming before the infliction of the wound, and the individual must have died, whether the wound had been inflicted or not. Indeed, the loss of blood would, in their opinion, have tended to stay the activity of the disease, and probably to prolong life. If we suppose that the wound in this case had been inflicted by another, on provocation, and that the examination of the body had fallen under the hands of a less careful practitioner, who might have neglected to examine the head, the accused party would have been charged with manslaughter and sent to trial. Here again the same witness being examined, and the prisoner remaining undefended, the evidence might have appeared sufficient to justify a conviction. No case can more strongly show the responsibility which may be attached to the duties of a medical witness. The punishment or acquittal of an innocent person, would depend on his medical skill ; for we cannot suppose, either that a barrister or a coroner, could always succeed in exposing an error of a nature so exclusively professional. This is a case which also teaches us the importance of constantly adhering to a principle of duty, already recommended,—namely, to examine the whole of the body in suspected death from local injuries. Supposing that in either of these cases, the life of the deceased had been insured—the policy would have been apparently vitiated ; and the truth could only have been ascertained by medical evidence. It is not enough to rest contented in any case with an *apparent cause* of death. At the inquest on the body of the late Mr. Serjeant Andrews, death was alleged to have taken place from hæmorrhage in the lungs, after the infliction of a suicidal wound in the throat. For a very instructive case by Mr. Berncastle, involving this question, see Lancet, Feb. 15, 1845, 185,—the deceased, a boy, died from strangulation of the intestine from morbid causes, after wrest-

ling with another boy. Another instance is related by Dr. Neumann, in which the question was somewhat doubtful. See Casper's Wochenschrift, May 24, 1845. It must, therefore, be borne in mind by a practitioner, that numerous causes of death may be lurking within the system at the time that a wound is criminally inflicted, and a close attention to the symptoms and post-mortem appearances, can alone assist him in the difficult position in which he may be placed, should the accused party be subsequently brought to trial. A man may be severely wounded, and yet death may take place from the bursting of an aneurism, from apoplexy, from phthisis, or other morbid changes which it is here unnecessary to specify. If death can be clearly traced to any of these diseases by an experienced surgeon, the prisoner cannot be charged with manslaughter: for the medical witness may give his opinion that death must have taken place about the same time, and under the same circumstances, whether the wound had been inflicted or not. On these occasions, however, one of the following questions would probably arise:—Was the death of the party accelerated by the wound, or was the disease under which he was labouring aggravated by the wound, so as to produce a more speedily fatal termination? The answer to either of these questions must depend on the circumstances of the case, and the witness's ability to draw a proper conclusion from these circumstances. If there were any reasonable doubt upon the subject, the prisoner, according to the humane principles of our law, would have the benefit of it. It is possible that a man may receive *two wounds* on provocation, at different times, and from different individuals, and die after the receipt of the second: in such a case, the course of justice may require that a medical witness should state which wound was the cause of death. Let us take the following illustration:—A man receives during a quarrel a gun-shot wound in the shoulder. He is going on well, with a prospect of recovery, when in another quarrel he receives a severe penetrating wound in the chest or abdomen from another person, and after lingering under the effects of these wounds for a longer or shorter period, he dies. If the gun-shot wound were clearly shown to have been the cause of death, the second prisoner could not be convicted of manslaughter; or if the stab were evidently the cause of death, the first prisoner would be acquitted on a similar charge. It might be possible for a surgeon to decide the question summarily, as where, for instance, death speedily follows the second wound; and, on inspection of the body, the heart or a large vessel is discovered to have been penetrated; or, on the other hand, extensive sloughing sufficient to account for death, might take place from the gun-shot wound, and on inspection the stab might be found to be of a slight nature and not involving any vital parts. In either of these cases, all would depend upon the science and skill of the medical practitioner,—his evidence would be so important that no correct decision could be come to without it; he is, in fact, called upon substantially to distinguish the guilty from the innocent. On some occasions, death may appear to be equally a consequence of either or both

of the wounds; in which case, probably, both parties would be liable to a charge of manslaughter. (See Ann D'Hyg. 1835, ii. 432.)

It may happen that the wounded person has taken *poison*, and actually died from the effects of this, and not from the injuries or maltreatment. Two cases of this kind are reported. Again, the wounded person may have been the subject of further ill-treatment, and the question will be put as to which of the two causes his death was really due. It may be observed of these cases, that the supervening disease, the poison, or the subsequent ill-treatment, should be of such a nature as to account for sudden or rapid death: since it would be no answer to a charge of death from violence to say that there were marks of chronic disease in the body, unless it were of such a nature as to account for the sudden destruction of life under the symptoms which actually preceded death. In the medical jurisprudence of wounds, there is probably no question which so frequently presents itself as this: it is admitted that the violence was inflicted, but it is asserted that death was due to some other cause; and the onus of proof lies on the medical evidence. Among numerous cases which have occurred in England during the last twelve years, I find that among the latent causes of death in wounded persons have been—inflammation of the thoracic or abdominal viscera,—apoplexy,—disease of the heart and large blood-vessels,—phthisis,—ruptures of the stomach and bowels from disease, twisting of the intestines,—and the rupture of deep-seated abscesses. In some of these, the person was in a good state of health up to the time of the violence, in others there was slight indisposition. The history is nearly the same in all:—it was only by careful conduct on the part of the medical witnesses, that the true cause of death was ascertained. It is obvious that questions of malapraxis and life-insurance, giving rise to civil actions, may have a very close relation to this subject. An imputation has often been thrown on the masters of schools, where boys have died soon after they have been chastised. In such cases there has been commonly some unhealthy state of the body to explain this result. When the disease which gives rise to doubt is seated in a part which is remote from that which sustained the violence, all that is required is, that the post-mortem examination of the body should be conducted with ordinary care. If the disease should happen to be in the part injured, the case becomes much more perplexing. The difficulty can then only be removed by attentively considering the ordinary consequences of such injuries. The violence may have been too slight to account for the diseased appearance; and the disease itself, although situated in the part struck, may be regarded as a most unusual consequence. A boy was struck two blows on the face by a magistrate; but they did not appear to have been very severe. The boy went to his work on the following day, but complained of pain in his head: he continued to work for two days, when he was seized with such severe pain that he was obliged to keep his bed. He became worse, and died fourteen days after the injury. A very minute inspection of the body was made, but the only morbid appearance found was a small

tumour on the dura mater, corresponding to the posterior face of the petrous portion of the right temporal bone. This satisfactorily accounted for death, but the examiners very properly denied that it had proceeded from the violence, because, 1, the tumour had evidently been for a long time forming, and many months before he was struck, the deceased had complained of his head. 2. It was also wholly improbable that the slight blows should, under any circumstances, have given rise to the formation of this deep-seated fungous excrescence. (Henke, Zeitschrift der S. A. 1837.) In other instances the case may be of a very doubtful character. A good illustration of this will be found in the Med. Gaz. xx. 503, in a case reported by Dr. Hughes, where a boy died apparently from the effects of a blow on the side, and after death peritonitis, ulceration of the bowels, an aperture in the diaphragm and gangrene of the lungs were found. The following is also, in this point of view, a remarkable case, which is related by Morgagni. An old man was caught in the act of robbing an orchard—he attempted to escape, but while running away received a blow on the back from the proprietor. The old man went on a few yards, and then fell dead. On inspecting the body, there were no external marks of violence. There was a large effusion of blood in the chest, which was traced to a rupture of the aorta, probably from the vessel being in an aneurismal state. The blow appeared to have been slight, and would probably have produced no evil consequences in a healthy person. (Barzellotti Questioni di Medicina Legale.)

CHAPTER XXXI.

WAS THE WOUND THE INDIRECT CAUSE OF DEATH.

Certain kinds of injuries are not immediately followed by serious consequences, but the individual may perish after a longer or shorter period of time, and his death may be as much a consequence of the injury as if it had taken place on the spot. The aggressor, however, is just as responsible as if the deceased had been directly killed by his violence, provided the fatal result can be traced to the usual and probable consequences of the injury. Wounds of the head are especially liable to cause death insidiously,—the person may in the first instance recover,—he may appear to be going on well, when, without any apparent cause, he will suddenly expire. It is scarcely necessary to observe that a post-mortem examination of the body will suffice to determine whether death is to be ascribed to the wound or not. In severe injuries affecting the spinal marrow, death is not an immediate consequence, unless that part of the organ above the origin of the phrenic nerves, be wounded. Injuries affecting the lower portion of the spinal column do not commonly prove fatal, until after some time; but the symptoms manifested by the patient during life, as well as the appearances observed in the body after death, will sufficiently connect the

injury with that event. Death may follow a wound, and be a consequence of that wound, at almost any period after its infliction. It is necessary, however, in order to maintain a charge of homicide against an individual, that death should be strictly and clearly traceable to the injury, and not be dependent on any other cause. A doubt on this point must, of course, lead to an acquittal.

Many cases might be quoted, in illustration of the length of time which may elapse before death takes place from certain kinds of injuries,—the injured party having ultimately fallen a victim to their indirect consequences. One of the most striking instances of this kind is that related by Sir A. Cooper, of a gentleman of Yarmouth, who died from the effects of an injury to the head, received about *two years* previously. In this case, the connection of death with the wound, was clearly made out by the continuance of the symptoms of cerebral disturbance during the long period which he survived. A case is reported in the Med. Chir. Rev. where a man died from the consequence of a rupture of the liver, which he had sustained *eight years* before (Jan. 1836, p. 296). Did it not rest upon good authority, I should be inclined to reject the following case, which formed the subject of a memoir, read before the Anatomical Society of Paris. An individual received a musket-shot in the left side of the thorax, and the ball remained lodged in the left lung during a period of *twenty-five years*. The ball, in penetrating, had fractured the humerus at its neck, in consequence of which the upper extremity had been amputated at the shoulder-joint. The wound of the chest soon healed, but the patient remained during life subject to fits of suffocation and hæmoptysis, under the effects of which he at length sank. On an examination of his body, the ball was found lying behind the third intercostal space in the midst of the pulmonary tissue, but lodged in a kind of cyst which communicated with the bronchi. Alison reports several cases where parties have been found guilty of homicide—the injured persons having died from the indirect results of the wounds after the lapse of three and five months and longer, (Criminal law, 151 ;) but there is a singular rule in our law relative to the period at which an individual dies from a wound, namely, that a party shall not be adjudged guilty of homicide unless death take place within a year and a day after receiving the wound. (Archbold, 345.) In the case of Mr. Smith, who was shot by the Hon. Ross Touchet, July 1844, death did not take place until eleven months after the wound and indirectly from it.

An individual who recovers from the immediate effects of a wound, may die from fever, inflammation or its consequences, erysipelas, tetanus or gangrene ; or an operation, required during the treatment of his wound, may prove mortal. These are what may be called secondary causes of death, or secondary consequences of the wound. The power of deciding on the responsibility of an accused person, for an event which depends only in an indirect manner on the injury originally inflicted by him, rests of course with the authorities of the law. But it is impossible that they can decide on so difficult and nice a question,

without satisfactory medical evidence; and on the other hand, it is right that a medical witness should understand the importance of the duty here required of him. Fever or erysipelas may follow many kinds of serious wounds, and in some few instances be distinctly traceable to them, but in others, the constitution of the patient may be so broken up by dissipated habits, as to render a wound fatal, which in a healthy subject might have run through its course mildly and have healed. When the fever or erysipelas is readily to be traced to the wound, and there is no other apparent cause of aggravation to which either of these disordered states of the body could be attributed, they can scarcely be regarded by the medical practitioner as very unexpected or unusual consequences of such injuries, especially when extensive, or when seated in certain parts of the body, as the scalp; therefore, if death take place, it does not appear unjust that the prisoner should be held as much responsible for the result as if the wound had proved directly mortal. This principle has already been admitted by our law, with regard to tetanus: and, indeed, were it not so, many reckless offenders would escape, and many lives would be sacrificed with impunity. It is difficult to lay down a general rule upon a subject which is liable to vary in its relations in every case; but when a wound is not serious, and the secondary cause of death is evidently due to constitutional peculiarities from acquired habits of dissipation, the ends of justice are probably fully answered by an acquittal; in fact, such cases do not often pass beyond a coroner's inquest.

These secondary causes of death may be arranged in three classes:

I. THE CAUSE IS UNAVOIDABLE.—Of this kind are tetanus, following laceration of tendinous and nervous structures,—erysipelas following lacerated wounds of the scalp,—peritoneal inflammation following rupture of the bladder or intestines, with extravasation of their contents,—strangulation of the intestines, as phrenic hernia, following rupture of the diaphragm, and others of the like nature. Here, supposing proper medical treatment and regimen to have been pursued, the secondary cause of death was unavoidable, and the fatal result certain.

II. THE CAUSE MIGHT HAVE BEEN AVOIDABLE BY GOOD MEDICAL TREATMENT.—There are, it is obvious, many kinds of wounds which, if properly treated in the first instance, may be healed, and the patient recover, but when improperly treated, they may prove fatal. In the latter case, it will be a question for the witness to determine, how far the treatment aggravated the effects of the violence, and from his answer to this, the jury may have to decide on the degree of criminality which attaches to a prisoner. Let us suppose, for instance, that an ignorant person has removed a clot of blood, which sealed up the extremity of a vessel, in consequence of which, fatal hæmorrhage has ensued,—or that he has produced death by unnecessarily interfering with a penetrating wound of the thorax or abdomen,—it would scarcely be just to hold the aggressor responsible, since, but for the ignorance and unskilfulness of his attendant, the wounded party might have recovered from the effects of the wound. When death is really traceable

to the negligence or unskilfulness of the person who is called to attend on a wounded party, this circumstance ought to be and commonly is admitted in mitigation, supposing that the wound was not originally of a mortal nature. Lord Hale observes: "It is sufficient to constitute murder, that the party dies of the wound given by the prisoner, although the wound was not originally mortal, but became so in consequence of negligence or unskilful treatment; but it is otherwise where death arises not from the wound, but from unskilful applications or operations used for the purpose of curing it." (i. 428.) The medical jurist will perceive that a very nice distinction is here drawn by this great judge, between death as it results from a wound rendered mortal by improper treatment, and death as it results from the improper treatment, irrespective of the wound. In the majority of cases such a distinction could scarcely be established, except upon conjectural grounds, and in no case would there be any accordance in the opinions of medical witnesses. In slight and unimportant wounds, it might not be difficult to distinguish the effects resulting from bad treatment from those connected with the wound, but, there can be but few cases of severe injury to the person, wherein a distinction of this nature could be safely made; and the probability is that no conviction for murder would now take place, if the medical evidence showed that the injury was not originally mortal, but only became so by unskilful or improper treatment. In such a case, it would be impossible to ascribe death to the wound or to its usual or probable consequences,—and without this it is not easy to perceive on what principle an aggressor can be made responsible for the result. One fact, however, it is important to notice. If the death be owing to the wound, it signifies not that under more favourable circumstances, and with more skilful treatment, the fatal result might have been averted. The following case is reported by Alison. The prisoner was one of a party of smugglers who fired at an officer of excise. The wounded man was carried to the nearest village, where he was attended by the surgeon of the country, who was not deficient in attention, but a great collection of matter having formed in the leg, fever ensued, and the patient died at the end of three weeks. In defence, it was urged that, by skilful treatment, the man might have recovered, but the court held that it was incumbent to prove that death arose *ex malo regimine*. The true distinction in all such cases is that if the death was evidently occasioned by grossly erroneous medical treatment, the original author of the violence will not be answerable; but if it arise from the want merely of the higher skill which can only be commanded in great towns, he will be responsible, because he has wilfully exposed the deceased to a risk from which he had practically no means of escaping. (150.) In the case of *Macewan*, (Perth Sept. Circ. 1830,) the prisoner was indicted for the manslaughter of a boy, by striking him on the shoulder, which dislocated the arm. Two days after the blow, an ignorant bonesetter was consulted, and owing to his manipulations inflammation took place, and, the boy being of a sickly and scrofulous habit, this proved fatal. Under the direction of

Lord Meadowbank the prisoner was acquitted. In charging the grand jury in reference to Mr. Seton's case, (Winchester Aut. Ass. 1845,) Mr. Baron Platt observed, that if a man inflicted a wound likely to produce death, and the wounded party should fall into the hands of an unskilful practitioner, whereby death was hastened, the aggressor would be responsible for the result. If the wound had not been likely to produce death, but by unskilful treatment death ensued, then that would not be murder.

It will be obvious that rather a serious responsibility is thrown on practitioners, who undertake the management of a case of criminal wounding. Any deviation from common practice should therefore be made with the greatest caution, since novelties in practice will, in the event of death, form one of the best grounds of defence in the hands of a prisoner's counsel. On these occasions, every point connected with the surgical treatment, will be rigorously inquired into. In the case of a severe lacerated wound to the hand or foot, followed by fatal tetanus, it may be said that the wounded person would not have died, had amputation been performed. In this instance, however, a practitioner may justify himself by showing that the injury was too slight to require amputation, or that the health or other circumstances connected with the deceased, would not allow of its being performed with any fair hope of success. On the other hand, if the practitioner performed amputation, and the patient died, then it would be urged that the operation was unjustifiable and had caused death. Here the surgeon is bound to show that the operation was necessary, according to the ordinary rules of treatment. The treatment of severe incised wounds of the throat, where the trachea is involved, sometimes places a practitioner in a very embarrassing position. If the wound be left open, death may take place from hæmorrhage: if it be prematurely closed, the blood may be effused into the trachea and cause death by suffocation. For an interesting case, in which the wounded person was alleged to have died through neglect on the part of the medical attendant, see B. & F. Med. Rev. xiii. 257.

III. THE CAUSE MIGHT HAVE BEEN AVOIDABLE HAD PROPER CARE BEEN TAKEN BY THE WOUNDED PERSON, OR HAD HE FOLLOWED THE ADVICE OF HIS MEDICAL ATTENDANT.—A man who has been severely wounded in a quarrel, may obstinately refuse medical assistance, or he may insist upon taking exercise, or using an improper diet, contrary to the advice of his medical attendant, or, by other imprudent practices, he may thwart the best conceived plans for his recovery. Let us take a very common case as an illustration. A man receives a blow on the head in a pugilistic combat, from the first effects of which he recovers, but after having received surgical assistance, he indulges in excessive drinking, and dies. The aggressor is tried on a charge of manslaughter and found guilty. Death under these circumstances is commonly attributed by the medical witness to extravasation of blood on the brain; but it cannot be denied that the excitement produced by intoxicating liquors, will sometimes satisfactorily account for the fatal

symptoms. In the case which we are here supposing, such an admission might be made, and the prisoner receive the benefit of it consistently with the proper administration of justice; for the imprudence or negligence of a wounded party ought not, morally or legally speaking, to be considered as adding weight to the offence of the aggressor. Of course it is presumed that there should be a fair prospect of recovery, so far as a prognosis could be given; for if the symptoms were from the first unfavourable, or the wound likely to prove mortal, these circumstances could not be received in mitigation. The more clearly the medical witness is able to trace death to imprudence or excess on the part of the deceased, in the case of a slight wound, the more obviously would the responsibility of a prisoner be diminished; and hence the necessity for attending to the progress of a wound, which, if it prove fatal, may involve another in a criminal charge. In the case of *Christian Paterson* (1823), referred to by Alison (p. 147), it appeared in evidence that the deceased was struck on the head with a smoothing-iron, which fractured her skull,—some days afterwards she drank a quantity of whisky, and was ultimately carried to the Royal Infirmary, where erysipelas shortly appeared in the wound, of which she died. In these circumstances, the charge of murder was departed from, and the accused was found guilty of assault. The legal responsibility of the assailant is the same, whether the deceased die on the spot, or some days, weeks or months afterwards, unless it can be distinctly proved that his death was immediately connected with the imprudence or excess of which he was guilty, and wholly independent of the wound. But, although a prisoner should be found guilty of manslaughter under these circumstances, the punishment is so adjusted by our law, as to leave a considerable discretionary power in the hands of a judge. This is, indeed, tantamount to a direct legal provision, comprehending each different shade of guilt;—a man is held responsible for a wound rendered accidentally mortal, by events over which he could have no control, and which in themselves ought to be regarded as in some degree exculpatory; but the punishment attached to his offence will be severe or slight, according to the representation made by a medical witness, of the circumstances which rendered the wound mortal; if he neglect to state the full influence of imprudence or excess on the part of the wounded person, where it has existed, over the progress of the wound, he will probably cause the prisoner to be punished with undue severity. The humanity of our judges is such, that when medical evidence is clear and consistent on a point of this nature, and there are no circumstances in aggravation, they commonly pass a mild sentence. (See case by M. Ollivier, Ann. D'Hyg. 1842, p. 128.)

Are we to class among acts of negligence on the part of a wounded person, sufficient to mitigate the offence of a prisoner, the not calling in a medical practitioner, or the refusing to receive medical advice? A wound susceptible of being cured, might thus prove mortal, and the prisoner be convicted of manslaughter. See the case of *Reg. v. Thomas*, p. 340.

A man may receive a lacerated wound of an extremity, which is

followed by tetanus or gangrene, and thus proves fatal ;—he may have declined receiving medical advice, or have obstinately refused amputation, although proposed by his medical attendant, but this would not be received as a mitigating circumstance on the part of a prisoner; because the wounded party is not compelled to call for medical assistance or to submit to an operation, and the medical witness could not always be in a condition to swear that the operation would have positively saved his life; he can merely affirm that it might have afforded the deceased a chance of recovery. In the case of the *Queen* v. *Hulme*, (Liverpool Aut. Assizes, 1843,) it was proved that the deceased had died from tetanus, caused by an injury to a finger some time before. Amputation was advised by the surgeon, but the deceased would not consent to the operation. The prisoner was convicted of manslaughter, and sentenced to the severest punishment prescribed by the law for that crime. In the case of *Mackenzie* (1827), the prisoner seized deceased by the throat, and bruised him severely in several parts of the body, in consequence of which tetanus supervened, and he died. Skilful medical advice was not called in till near the end of the illness, when tetanus had already come on, and in the interval he had acted imprudently and aggravated the symptoms. The medical evidence clearly proved that the tetanus was owing to the injury, and was a frequent result of it. The prisoner, under the direction of the Court, was convicted, and subsequently transported. Again, a person may receive a blow on the head, producing fracture with great depression of bone, and symptoms of compression of the brain :—a surgeon may propose the operation of trephining to elevate the depressed bone, but the friends of the wounded man may not permit the operation to be performed. In such a case, his line of duty will be to state the facts to the Court, and it is probable that here, at least, some mitigation of punishment might take place on conviction ; because such an injury, if left to itself, must in general prove mortal, and no doubt could exist in the mind of any surgeon, as to the absolute necessity for the operation. But the neglect or improper conduct of the person who receives the wound, furnishes no excuse to the aggressor. It is either murder or manslaughter.

IV. THE CAUSE MIGHT HAVE BEEN AVOIDABLE BUT FOR AN ABNORMAL OR UNHEALTHY STATE OF THE BODY OF THE WOUNDED PERSON.—Wounds which are comparatively slight, sometimes prove indirectly fatal, owing to the person being in a diseased or unhealthy state, at the time of their infliction. In bad constitutions, compound fractures or slight wounds are followed by gangrene, fever, or erysipelas, proving fatal, which in a healthy subject would probably have had a favourable termination. Here the responsibility of an assailant for the death if it did not cease, may be considerably reduced, so that although found guilty of manslaughter a mild punishment may be inflicted. The consequence may be, medically speaking, unusual or unexpected, and but for circumstances wholly independent of the act of the accused, would not have been likely to destroy life. In general, in the absence of

malice, this is the point to which the law closely looks, in order to make out the responsibility of the accused :—namely, that the fatal secondary cause must be something not unusual or unexpected as a consequence of the particular injury, and the medico-legal question presents itself under this form :—Would the same amount of injury have been likely to cause death in a person of ordinary health and vigour? Men who have suddenly changed their habits of living, and have passed from a full diet to abstemiousness, are unable to bear up against comparatively slight injuries, and often sink from their secondary consequences. So a man otherwise healthy labouring under hernia, may receive a blow in the groin, attended with rupture of the intestine, gangrene and death,—another with a calculus in the kidney may be struck in the loins, and die in consequence of the calculus perforating the renal vessels, and causing fatal hæmorrhage, or from subsequent inflammation. Mr. Crosse, of Norwich, has reported to the Medico-Chirurgical Society the case of a boy, aged ten, who received a slight blow on the abdomen, and died in a very unexpected manner on the second day after the injury. On inspection, a cyst capable of holding ten or twelve ounces of liquid, was found connected with the under surface of the liver. The cyst had been ruptured by the blow, and its contents had escaped into the abdomen. But for the cyst existing in this situation, the blow would not have been attended with dangerous consequences. In these cases, the effects of the violence must be regarded as something unexpected :—it would not have produced serious mischief in an ordinarily healthy person, and hence the responsibility of an assailant becomes much diminished. The crime is undoubtedly manslaughter, but the punishment would be of a mild description. A defence of this kind will however be limited by circumstances. A case is reported where a Dr. Fabricius was tried at the Old Bailey for the murder of his female servant by striking her a blow behind the ear, whereby a large abscess, situated at that part, was ruptured, and this ultimately caused her death. The chief question on the trial was, whether the deceased had died from the effects of the violence or of the disease under which she was at the time labouring. The doctor ingeniously urged in his defence that he had struck the blow merely with the purpose of opening the abscess! The jury, however, did not agree in taking this scientific view of the matter, and they found him guilty of manslaughter. In the case of the *Queen* against *Bell* and others, (Nott. Aut. Assizes, 1841,) it was proved that the deceased had died from the effects of a blow received in a prize-fight, which had ruptured an abscess in the kidney, evidently of long standing. The prisoners were convicted.

It must be evident that there exist numerous other internal diseases, such as aneurism, and various morbid affections of the heart and brain, which are liable to be rendered fatal by slight external violence. Now the law, as applied to these cases, is thus stated by Lord Hale :—"It is sufficient to prove that the death of the party was accelerated by the malicious act of the prisoner, although the former laboured under a

mortal disease at the time of the act." (1. 428.) In those cases, where a slight degree of violence has been followed by fatal consequences, it is for a jury to decide under all the circumstances of the case, upon the actual and specific intention of the prisoner at the time of the act which occasioned death. And, according to Starkie, "it seems that in general notwithstanding any facts which tend to excuse or alleviate the act of the prisoner, if it be proved that he was actuated by prepense and deliberate malice, and that the particular occasion and circumstances upon which he relies, were sought for and taken advantage of merely with a view to qualify actual malice, in pursuance of a preconceived scheme of destruction, the offence will amount to murder." In most of these cases there is an absence of intention to destroy life: in general, the very nature of the wound, as well as the means by which it was inflicted, will suffice to develope the intention of the prisoner. An accurate description of the injury, if slight, will often afford strong evidence in favour of the prisoner, since the law does not so much regard the means used by him to perpetrate the violence, as the actual intention to kill or to do great bodily harm. Serious injury, causing death by secondary consequences, will admit of no exculpation when the prisoner was aware, or ought to have been aware of the condition of the party whom he struck. Thus if a person notoriously ill or a woman while pregnant, be violently maltreated and death ensue from a secondary cause, the assailant would be held responsible; because he ought to have known that violence of any kind to persons so situated, must be attended with dangerous consequences. So if the person maltreated be an infant or an infirm and decrepid old man, or one labouring under a mortal disease, it is notorious that a comparatively slight degree of violence will destroy life in these cases; and the prisoner would properly be held responsible. A wound which *accelerates* death may therefore render the aggressor responsible for murder or manslaughter according to the circumstances.

When the assailant could not have been aware of the existence of a diseased or an abnormal condition of parts in the wounded person, the question is somewhat different. In many individuals the skull is preternaturally thin, and in most persons it is so, in those places corresponding to the situation of the glandulæ Pacchioni. In a case of this kind a moderate blow might cause fracture, accompanied by effusion of blood,—depression of bone—or subsequent inflammation of the brain and its membranes, any of which causes might prove fatal. An important trial involving this question occurred at the Norwich Summer Assizes, in 1842. (*The Queen against Dowde.*) The prisoner, who was a policeman, was charged with manslaughter. The deceased, it appears, attempted to escape from the custody of the prisoner, and the latter, in endeavouring to prevent his escape, struck the deceased a blow on the head. The deceased spoke of the blow as trifling, and with the exception of a slight head-ache, he made no complaint. On examining his head, there was a very slight cut, and a small effusion of blood. The deceased was placed in a cell, and some hours afterwards

was found dead. On inspection, the skull was found fractured for an inch and a half over the seat of violence, and a quantity of blood had been effused and had caused death. The medical evidence on the trial was to the effect, that the blow did not appear to have been violent—that the skull of the deceased was preternaturally thin, not being more than one-twelfth of an inch in thickness at the fractured part. All agreed that the fracture might in this case have been caused by a blow, which, under ordinary circumstances, would have been attended with no serious mischief. In some persons, all the bones of the body are unusually brittle, so that they are fractured by the slightest force. Inflammation, gangrene and death may follow, when no considerable violence has been used; but these being unexpected consequences and depending on an abnormal condition of parts unknown to the prisoner, his responsibility will not be so great as under other circumstances. This condition of the bones can only be determined by a medical practitioner. Facts of this kind show that the degree of violence used in an assault cannot always be measured by the effects, unless a careful examination of the injured part, be previously made.

Some German medical jurists have contended that an unnatural transposition of parts should become a mitigating circumstance,—as when, for example, the heart or some large vessel is found out of its position and there wounded; but this doctrine will receive no sanction from an English Court of law, as the responsibility of persons for these criminal offences, does not rest upon the perfect anatomical structure of the deceased! At the same time, it might become a question whether if death occurred from a superficial wound,—whereby a large artery taking an abnormal course, was divided,—there might not be cæteris paribus some ground for diminishing the degree of responsibility. When a person is charged with having caused the death of another through violence terminating in some fatal disease, the case often admits of an able defence, and this in proportion to the length of time after the violence, at which the deceased dies. The disease, it may be urged, is liable to appear in all persons, even the most healthy,—or it may have arisen from causes unconnected with the violence. In admitting these points, it must be remembered that death may be proved to have been indirectly a consequence of the wound by the facts: 1, that the supervention of the secondary cause, although not a common event, lay in the natural course of things; 2, that there did not exist any accidental circumstances which were likely to have given rise to this secondary cause independently of the wound. The proof of the first point amounts to nothing, unless the evidence on the second point be conclusive. According to Lord Hale, if a man have a disease which in all likelihood would terminate his life in a short time, and another give him a wound or hurt which hastens his death, this is such a killing as constitutes murder. (Archbold, 345.)

Tetanus.—This disease frequently presents itself as a secondary fatal consequence of wo unds,—more especially of those which are

lacerated or contused, and affect nervous or tendinous structures. It has often occurred as a result of very slight bruises or lacerations, where the injury was so superficial as to excite no alarm; and it is a disease which gives no warning of its appearance. It is very important for a medical jurist to know that it may come on spontaneously, i. e. independently of the existence of any wound on the body. Many cases have been brought into the London hospitals, where the only cause of this disease, appeared to be exposure to cold or wet,—or exposure to a current of air. (Lancet, Dec. 14, 1844, 351.) It has sometimes come on without any apparent cause. In endeavouring to connect its appearance with a particular wound or personal injury, it will be proper to observe: 1, whether there were any symptoms indicative of it before the maltreatment; 2, whether any probable cause could have intervened to produce it, between the time of its appearance and the time at which the violence was inflicted; 3, whether the deceased ever rallied from the effects of the violence. The time at which tetanus usually makes its appearance, when it is the result of a wound, is about the third or fourth day.

Many trials for wounding have occurred in this country of late years, where tetanus was the immediate cause of death; and the defence has generally rested upon the probable origin of the tetanus from accidental causes. Perhaps among these that of *Captain Moir*, who was tried at the Chelmsford Assizes in 1830, for the murder of a fisherman, is one of the most interesting, as it developes the rule of law in regard to criminal responsibility, when death takes place from secondary causes.

The deceased had repeatedly trespassed on the grounds of the prisoner, but, notwithstanding the frequent warnings which he had received, he set the prisoner at defiance. On the day laid in the indictment, the prisoner, while riding, met the deceased crossing his grounds, in order to pursue his usual occupation of fishing. An angry altercation took place, and the deceased refused to return: the prisoner, in a high state of irritation, then rode back to his house, which was at some distance from the spot; and, having procured his pistols, rode off after the deceased, and overtook him in the act of continuing the trespass. Words again ensued between them, and the prisoner then fired at the deceased and wounded him severely in the arm. The muscles, vessels, and nerves were extensively lacerated, but so far as I have been enabled to learn the particulars, no question seems to have been raised respecting the propriety of immediate amputation. The deceased lingered a short time: tetanus supervened, under which he died. On the trial, the medical evidence went to show that death was caused by tetanus brought on by the severe gun-shot wound inflicted by the prisoner. In his defence, it was alleged that he shot the deceased under provocation: and that he had not intended to kill him, for he had purposely aimed at the arm. With regard to the first point, the judges held that the fact of his returning to his house, to fetch a weapon capable of inflicting a mortal wound, was a proof of deliberate malice; while, with regard to the second point, there could be no extenuation, since a serious wound inflicted on an extremity may destroy life as readily as a wound inflicted on the trunk. The prisoner was found guilty and executed, but his execution was considered by many to be *summum jus*. In this case, the connection of the secondary cause of death, with the original wound, appeared to be so clear, that not a doubt existed in the minds of the professional witnesses; and the law held the prisoner to be

as much responsible for the fatal result, as if he had killed the deceased on the spot.

The next point which we have to consider is the degree of responsibility which attaches to an assailant, when death takes place from an operation, rendered necessary in the treatment of wounds.

V. DEATH FROM SURGICAL OPERATIONS.—It must here be presumed, that the operation is imperatively necessary, i. e. that without it the wound is likely to prove fatal, and that it has been skilfully performed; for these are two conditions, without the existence of which, the responsibility of a prisoner for the consequences, could not be entertained. A prudent practitioner would, therefore, never operate under the circumstances here supposed, without requiring the advice and assistance of his brother practitioners; otherwise, as it has been observed, a criminal may escape punishment, at the expense of the surgeon's reputation. There is no specific provision on this point in our law. According to Lord Hale, if death take place from an unskilful operation, performed for the cure of a wound, and not from the wound, the responsibility of a prisoner ceases; but this eminent lawyer does not appear to have contemplated, that death might take place as a consequence of the most skilful operation required for the treatment of a wound, and yet be wholly independent of the wound itself. A wounded person may sink from the mere shock of an operation, or he may die from the quantity of blood unavoidably lost during its performance. On the other hand, he will apparently be going on favourably, when secondary hæmorrhage may ensue, and suddenly destroy him. The operation may also take an unfavourable turn in its results, if the individual be at the time the subject of internal organic disease, in which case, it seems reasonable that the responsibility should be considerably diminished. Mr. Travers observes, that,—A pre-existing disease of the liver, kidney, or testicle, though chronic, and in itself not alarming to the constitution, becomes a drag upon its elasticity, and stands in the way of recovery. Inspection of the body after death, frequently explains the unfavourable result of operations that promise well, by discovering one or more organs in a state of chronic disease, which had not previously deranged the health in a degree sufficient to give notice of its existence; and which might, therefore, have remained quiet for years to come, had no extraordinary call been made upon the powers of the system. (On Constitutional Irritation, p. 45, 121, et seq.)

Should an operation be unnecessarily or unskilfully performed, the responsibility of an aggressor would of course cease, if the death of a wounded party could be clearly ascribed to it. Thus if in carelessly bleeding a wounded person, the brachial artery should be laid open, (See Ann. D'Hyg. 1834, ii. 445.) or if in performing amputation, a large artery be imperfectly secured, so that the patient in either case, die from hæmorrhage, the prisoner is not responsible; because it would be punishing him for an event depending on the unskilfulness of the medical practitioner. But supposing the bleeding or amputa-

tion to be performed with ordinary care and skill; and yet, in the one case, phlebitis, and in the other tetanus, gangrene, or fever should destroy life, the prisoner would be differently situated. The practice of the law is strictly consistent with justice. If the operation be *absolutely* required for the treatment of a wound, which according to all probability will prove mortal without it,—if it be performed with ordinary skill, and still death ensue as a direct or indirect consequence, the prisoner will be held responsible for the result. It is presumed in these cases, that if the patient were left to himself, he would, in all probability, die from the effects of the wound. If, therefore, a surgeon, knowing that an operation would give a chance of saving life on such an occasion, did not perform it, it might be successfully contended in the defence, that the deceased had died, not from the wound, but from the incompetency and neglect of his medical attendant. Hence it follows, that if during this very necessary treatment, unforeseen though not unusual causes cut short life, no exculpation should be admissible, if it went to attack the best directed efforts made for the preservation of life. (See Ann. D'Hyg. 1835, i. 231.)

By an operation being *absolutely required,* we are to understand that it is necessary to preserve life, i. e. that the wound will probably prove fatal without it. Bleeding and cupping may be necessary in the treatment of a wounded person; but unless it could be sworn that this treatment was required for the preservation of life from the injury inflicted, it is doubtful whether, in the event of death occurring from these simple operations, the assailant would be held responsible for the fatal result. In 1827, two persons were tried in Edinburgh, for capitally assaulting another, by throwing sulphuric acid over him. The death of the deceased was clearly due to phlebitis and concomitant fever, following the operation of venesection, which was considered necessary in the treatment of the case. It did not appear that this bleeding was absolutely necessary for the preservation of life, but merely for the prevention of severe ophthalmia. The charge of murder was therefore abandoned:—this question of responsibility for the fatal result being considered to involve too nice a point to ensure conviction. (Ed. M. and S. J., April 1829, 230.) Death is by no means an unusual result of severe operations, the secondary consequences under which the patient may die, being very numerous even when the case is most skilfully managed. Sometimes the patient will die on the table, although but little blood may have been lost:—in a case related by Dr. Evans, of Galway, the patient, a healthy man, who had sustained a severe injury by an accident, died in a few moments after his leg had been amputated, although he had not lost more than four ounces of blood. Fear, pain, and sudden shock to the nervous system have caused death under these circumstances. The most common indirect causes of death after these operations, are tetanus and hectic fever with gangrene of the stump. If the operation were really necessary, and it thus ultimately proved fatal, the prisoner would be responsible for the death. An interesting case involving this question

was tried at the Limerick Spring Assizes, in 1836. It was communicated to me by Dr. Geoghegan, of Dublin. The deceased received a comminuted fracture of the leg produced by blows. He was taken to an hospital, when signs of mortification began to make their appearance in the injured limb. It was proposed on a consultation of surgeons, to remove the limb. Amputation was skilfully performed, and there were some hopes of recovery; but in ten days, tetanus came on as a result of the operation, and the man died. The persons who inflicted the injury were indicted and convicted of the murder. The conviction was confirmed by a conference of the judges. (*The King against Michael Quain and others.*)

When a wounded person is taken to an hospital in which gangrene or erysipelas is diffusing itself by infectious propagation, and he is attacked by one of these diseases before or after the performance of an operation, and dies, it is doubtful whether a prisoner would be held responsible for the result, unless the disease were proved to be not an unusual consequence of the injury so inflicted. It might be contended, that the transportation of the wounded man to such a locality was not absolutely necessary to the preservation of his life; and that he would not then have died but for the accidental presence of an infectious disease. Cases of this kind cannot be easily decided by general rules; but the question has already been raised before a legal tribunal, in a trial which took place at the Maidstone Lent Assizes, 1839. *(The Queen against Connell and others.)* The deceased was assaulted by a number of soldiers, and received two blows on the head with a stick. The wound was not of any great extent, and the deceased did not appear to suffer much from it. Two days afterwards, he was attacked by erysipelas in the head and face, and he died in about a week. On inspection, there was no appearance of disease. The surgeon referred death to erysipelas, which was prevalent in the hospital, at the time the deceased was brought in. The man would probably have recovered but for the attack of erysipelas, and he did not think that he would have been attacked by that disease but for the wound. Erysipelas was an infectious disease and a common consequence of wounds of the head. Upon this evidence the prisoners were convicted. It is sometimes very difficult to establish the connection of the *erysipelas* with a wound, especially when the disease occurs in a remote part of the body, not implicated in the wound. When this cannot be distinctly made out there will be an acquittal. The following case was tried before the Justiciary Court at Glasgow, in 1822. A gamekeeper to Lord Blantyre, was indicted for the murder of a poacher, whom he shot so severely in the left arm, that it was found necessary to perform amputation above the elbow. The man died of erysipelas in the right leg; and the question on the trial was, whether the erysipelas was brought on by the gun-shot wound or not. Upon this question, there was great difference of opinion among the medical witnesses. One gave it as his opinion, that the debility caused by the wound, brought on the disease of which the deceased

died. Another thought that the tendency to erysipelas had existed long before the man received the wound. It appeared in evidence, that the deceased had been out for two nights in the exercise of his vocation, and had slept without shelter,—that during this time, he had eaten but little, and above all, that he had a foul ulcer in his leg, the absorption of matter from which, in the opinion of some of the witnesses, had laid the foundation of the disease before the injury was received. "Under all these circumstances," observes the reporter, "what would have been the best mode of treatment in such a case, supposing the deceased had received no wound at all? Undoubtedly," he continues, "the very treatment which he did receive in consequence of it;—copious bleeding,—light diet,—and perfect rest: while the counter-irritation from the amputation, so far from increasing the inflammation which was going on in the groin, must have acted like a blister or a seton in repressing and counteracting it!" The jury seem to have agreed in this view of the case, for the prisoner was acquitted of the charge. (Beck's Med. Jurisprudence, Wounds.) Taking the circumstances as they are above reported, it certainly did not appear that the erysipelas was directly connected with the wound, and unless this had been clearly and satisfactorily proved, it would have been unjust to have made the prisoner responsible for the fatal consequences. The bad habit of body and the actual existence of disease in the leg, were facts in themselves sufficient to render such an opinion improbable. But in addition to this it is stated by Alison that erysipelas was at the time prevalent in the Glasgow Infirmary, and deceased was put into a bed formerly occupied by a patient with that disorder. Until then the wound presented no peculiarly dangerous symptoms.

It may happen that the operation has been skilfully performed under a *mistaken diagnosis*. Carcinomatous tumours have been occasionally mistaken for aneurism, the artery has been secured and death has followed. A case occurred in Dublin in July 1844, in which the carotid artery was tied.—and another in London in 1845, in which the operation was performed on the common iliac artery, for supposed aneurisms. In both cases the patients sank, and after death it was found that the tumours were not aneurismal. This question derives importance from a case which has lately occurred at Portsmouth (June 1845) in which a *Mr. Seton* was shot in a duel. A tumour formed in the course of the pistol-shot-wound at the lower part of the abdomen; and this was supposed to be owing to an aneurismal enlargement from a wound in or injury to the femoral artery, for which the external iliac was tied. The patient died from the peritoneal inflammation following the operation, and on inspection it was found that the tumour was formed by a mass of coagulated blood poured out not from the femoral, but from one of its superficial branches. According to the report, there was a difference of opinion about the necessity for the operation. One witness thought that it was not absolutely necessary to perform it at the time.—Another thought it absolutely necessary, under the circumstances, in order to save life. The real ques-

tion appears to be, Was it necessary to tie the external iliac artery at the time, for an injury to a superficial branch of the femoral? Was it quite impossible that the patient should recover from the wound without the performance of the operation at that time? There does not appear to have been any doubt that the operation was skilfully performed; and peritoneal inflammation was not unlikely to be a fatal consequence. If, however, it was not absolutely necessary to save life, as the post-mortem examination would tend to show, and the wound itself was not considered mortal, it is doubtful how far the prisoner can be made responsible for the fatal result. (Med. Gaz. xxxvi. 385.)

It has been a question whether slight deviations from the ordinary mode of performing operations, should involve a practitioner in a charge of malapraxis. I am not aware that this question has been raised in England; but a remarkable instance occurred in the United States last year, in which an action was brought and damages recovered against a medical man for alleged negligence in vaccinating a young female, (case of *H. L. Landon.*) Some cutaneous inflammation followed the operation, which, it was alleged, was performed nearer to the elbow-joint than was usual. The plaintiff soon recovered from the effects. The most singular feature of this case was the ruling of the judge: he said "In performing the operation of vaccination or inoculation, the physician is liable for all consequences, if he neglects the usual precautions or fails to insert the virus in that part of the arm *usually selected* for the purpose; notwithstanding many other parts of the body might be proved to be equally proper and even more suitable locations!" If this be law, it is a very singular specimen of transatlantic jurisprudence. It might as well be ruled that a limb should always be taken off with a particular kind of knife and the bone sawn through with a *normal* saw; and in case of infringement, that the operator should be made responsible for the result!

A case interesting in relation to this subject was tried at the Norfolk Lent Ass. 1845. *(Gibbs v. Tunaley.)* An action was brought against the defendant, a surgeon, for alleged negligence and want of skill in treating an injury to the foot, which the plaintiff had sustained. Mortification took place, and amputation was obliged to be performed. The plaintiff and his witnesses alleged that the mortification was caused by tight bandaging, but the defendant brought good medical evidence to show, that it was most probably due to the extensive violence from the accident, (a railway accident,) and there is but little doubt that this was the correct view of the case. Mr. Baron Parke observed in his charge, "that they (the jury) were not to expect from a country practitioner the same amount of eminent skill to be met with in large towns: but they had a right to expect from persons so situated the usual and ordinary amount of skill, care and attention which it was only reasonable to suppose he would possess: and if in the discharge of his duty he applied his professional skill and knowledge to the best of his ability, then, however unfortunate the termination of the case, he was not to be visited with an action to mulct him for damages. Such a step would be most unjust, and have an injurious tendency, as it would check that independence of action, so necessary for medical men to possess." Damages one farthing! There can hardly be a doubt that many of these trivial actions for alleged *malapraxis*, are brought against medical practitioners, as affording a very convenient method of settling a long account.

In the case of *Baker v. Lowe* (Queen's Bench, Feb. 1845) a medical man brought an action against the defendant for the amount of his bill, and the defence was that he had been unskilfully and improperly treated. The defendant had been attacked with senile gangrene in the toe,—the toe was removed, but the disease involved the foot, and amputation was again performed. The plaintiff had adopted a stimulating plan of treatment in the first instance, which it was alleged was improper. The medical evidence was very conflicting, and the only inference which can be deduced, is that in some cases a stimulating, and in others an antiphlogistic treatment is admissible. The plaintiff brought two experienced witnesses who approved of his treatment, and the jury returned a verdict for the greater part of the amount claimed. (See Med. Gaz. xxxvi. p. 126.) When there is such a division of opinion among men of equal experience, a practitioner has a right to expect that a verdict will be returned in his favour; since it is not to be supposed that in order to recover payment for a bill or to answer a charge of unskilfulness, a man's practice should receive the approval of the *whole* of his professional brethren, especially in cases where there is an acknowledged difference of opinion respecting the treatment. On this showing, a man would never be able to recover his charges for the treatment of a case of severe burn or scald: since some practitioners consider it malapraxis to adopt the stimulating, while others equally regard it as malapraxis, to adopt the cooling plan of treatment! All that appears to be expected, is a reasonable accordance with received professional doctrines.

Questions relative to responsibility in death following operations, would come more frequently before Courts of law, were it not that the cases are often stopped in the Coroners' courts by a verdict of accidental death. (See Med. Gaz. xix. 157.) It unfortunately happens that on these occasions, there is great difference of opinion among medical witnesses respecting the connection of the disease with death, or indeed the necessity for the operation itself. The evidence of opinion in favour of the prosecution here, as in action for malapraxis, is sometimes exactly balanced by that urged in the defence; and under these circumstances, the only alternative left to the Court, is to discharge the accused. Differences upon these subjects among eminent members of the profession, too justly convey to the public, the impression that there are no fixed principles upon which medical opinions are based; and consequently that it would be dangerous to act upon them. Thus it is that we are accustomed to hear of a medical prosecution and a medical defence, as if the whole duty of a medical jurist consisted in his making the best of a case, on the side for which he happens to be engaged, adopting the legal rule of suppressing those points which are against him, and giving an undue prominence to others which may be in his favour. This is an evil, for which at present there appears to be no other remedy, than that of appointing a medical board of competent persons to whom such questions might be referred, in the same way as questions relative to navigation, are referred by the Admiralty Courts to a board formed of members of the Trinity House,—professionally acquainted with the matters in litigation.

CHAPTER XXXII.

FOR HOW LONG A TIME HAS THE WOUND BEEN INFLICTED? HOW LONG DID THE DECEASED SURVIVE?

The period of time at which a particular wound was inflicted, may become a medico-legal question, both in relation to the living and the dead. The identity of a person and the correctness of a statement made by an accused party, may be sometimes determined by an examination of the wound or its cicatrix. So, if a dead body be found with marks of violence upon it, and evidence adduced that the deceased was maltreated at some particular period before his death, it will be necessary for a practitioner to state whether, from the appearance of the injuries, they could or could not have been inflicted at or about the time. A case was tried at the Taunton Spring Assizes, 1841, *(the Queen against Raynon,)* wherein evidence of this kind served to disprove the statement made by the accused. He was charged with maliciously cutting and wounding the prosecutrix. There was a cut upon his thumb, which he accounted for by saying it was from an accident which occurred three weeks before. The medical witness declared, on examining it, that it could not have been done more than two or three days, which brought the period of its infliction to about the time of the murderous assault. This and other circumstances led to his conviction.

An incised wound inflicted on the living body, gradually heals by adhesion when no circumstances interfere to prevent the union of the edges. For eight or ten hours the edges remain bloody,—they then begin to swell, showing the access of inflammation. If the parts be not kept well in contact, a secretion of a serous liquid is poured out for about thirty-six or forty-eight hours. On the third day this secretion acquires a purulent character. On the fourth and fifth days, suppuration is fully established, and it lasts five, six, or eight days. A fibrous layer then makes its appearance between the edges, which is at first soft and easily broken down:—this causes them gradually to unite, and thus is produced what is termed a *cicatrix*. Cicatrization is complete about the twelfth or fifteenth day, when the wound is simple, of little depth, and only affecting parts endowed with great vitality. The length of time required for these changes to ensue will depend—1. On the situation of the wound,—wounds on the lower extremities are longer in healing, than those on the upper part of the body. If the wound be situated near a joint, so that the edges are continually separated by the motion of parts, cicatrization is retarded.

2. On the extent. Wounds involving many and different structures, are longer in healing than those simply affecting the skin and muscles. 3. On the age and health of the wounded party;—the process of cicatrization is slow in those who are diseased or infirm. In an incised wound, the cicatrix is generally straight and regular:—but it is semilunar if the cut be oblique. It is soft, red and tender if cicatrization be recent:—it is hard, white, and firm, if of long standing. On compressing the skin around an old cicatrix, its situation and form are well marked by the blood not entering into it on removing the pressure. It has been said, that the cicatrices of incised wounds are linear, but that is not always the case:—in general, they are more or less elliptical, being wider in the centre than at the two ends,—this appears to be due principally to the elasticity of the skin and the convexity of the subjacent parts:—thus it is well known, that in every wound on the living body the edges are much separated in the centre, and this physical condition influences the process of cicatrization. When the wound is in a hollow surface, or over a part where the skin is not stretched, as in the axilla or groin, then the cicatrix may be linear or of equal width throughout. If there were any loss of substance in an incised wound, or if the wound were lacerated or contused, the cicatrix would be irregular and the healing would proceed by granulation. The process might here occupy five, six, or eight weeks, according to circumstances. When healed, the cicatrix would be white and have a puckered appearance;—the surface of the skin would be uneven. (See an essay on this subject by Dr. Krügelstein Henke Zeitschrift der S. A. 1844, ii. 75.)

Is a cicatrix always a consequence of a wound? If we here use the term wound in the sense in which it is commonly employed in jurisprudence,—i. e. where the breach of continuity affects the layers of the true skin, a cicatrix is always produced in the process of healing. In even cuts made by a very sharp instrument, especially if they be in the direction of the fibres of subjacent muscles, and the parts be kept in close apposition, the cicatrices are even, linear, and sometimes so small as to be scarcely perceptible. If, besides, the skin be white, they may be easily overlooked. Wounds of this kind are not, however, commonly the subject of a medico-legal inquiry. If then on examining a part, where at some previous time a stab or a cut is alleged to have been received, we find no mark or cicatrix. it is fair to assume that the allegation is false, and that no wound has been inflicted, making due allowance for the fact that mere abrasions of the cuticle, or very slight punctures and incisions, often heal without leaving any well-marked cicatrix. Is a cicatrix when once formed ever removed, or so altered by time as to be no longer recognizable? This is rather an important question, which sometimes presents itself to a medical jurist both in civil and criminal proceedings. Those who have given close attention to this subject, agree in considering that cicatrices when they are once so produced in the cutis as to be easily perceptible, are indelible. They

undergo no sensible alteration in their form or other external characters. The tissue of which a cicatrix is formed is different from that of the skin:—it is harder and less vascular, and is destitute of rete mucosum, so that its whiteness, which is particularly remarkable on the cicatrized skin of a negro, is retained through life. If any cicatrices were easily obliterated it would be those which are even and regular,—the results of incised wounds by sharp instruments; but from my own observation, I can undertake to say, that cicatrices of this kind have certainly retained their characters unchanged in one instance for twenty, and in another twenty-five years. According to the observations of Dupuytren and Delpech, the substance of a cicatrix is not converted into true skin:—it never acquires a rete mucosum. In the cicatrices of lacerated and contused wounds, the form of the weapon with which the wound was inflicted, is sometimes indicated. It is not, however, easy to distinguish the cicatrix of a stab from that produced by a pistol-bullet fired from a distance. In both cases the edges may be rounded and irregular, unless the stab has been produced by a broad-bladed weapon.

It is important to observe that all cicatrices are of smaller size than the original wound; for there is a contraction of the skin during the process of healing. This is especially observed with regard to the cicatrix of a stab. The recent wound, as it has been elsewhere stated, (antè, p. 301) is apparently smaller than the weapon, and the resulting cicatrix is always smaller than the wound. Hence it is difficult to judge of the size of the weapon from an examination of the cicatrix. In gun-shot wounds, if the projectile has been fired from a distance, the cicatrix is of less diameter than the ball:—it represents a disk depressed in the centre and attached to the parts beneath; while the skin is in a state of tension from the centre to the circumference. If the bullet have been fired near the body,—the cicatrix is large, deep and very irregular. If the projectile have made two apertures, the aperture of exit is known by the greater size and irregularity of the cicatrix. When an individual is not seen until after death, and there are recent wounds on his body, a medical jurist may be required to state at what period they were probably inflicted. It may be taken as a general rule that there are no appreciable changes in any wound until eight, ten, or twelve hours have elapsed from the time of its infliction; then we have the various phenomena of adhesion, suppuration or gangrene, during any of which stages the wounded person may die. Some remarks have already been made on the time at which adhesion and suppuration become established in wounds; and with respect to gangrene it may be observed, that the deceased must have survived at least fifty hours, in order that this process should be set up:—in old persons it may take place earlier. We must take care not to confound the effects of putrefaction on a wound with those of gangrene. Putrefaction always commences sooner in parts which are wounded than in those which are unaffected; but the general appearance of the body will show whether or not the changes in the wound

are due to putrefaction. The collapse of the eye will indicate this process; while the presence of warmth or rigidity of the members will show that death must have been too recent for putrefaction to have become established.

The time at which a severe contusion has been produced, may be commonly determined by noting the changes of colour which take place around it. It is rarely until after the lapse of twenty-four or thirty-six hours that these changes of colour appear. (See Ecchymosis, ante, p. 291.) The livid circumference passes into a green circle, which is gradually diffused into a wide straw-yellow band, bounding the ecchymosis on every side, if it be in a free or loose part of the skin. In four, five, or six days, the dark livid colour slowly disappears from the circumference to the centre, while the coloured bands spread more widely around. A central dark spot may be perceived after ten days or a fortnight, and in a very extensive ecchymosis, it is some weeks before all traces of it are lost. The rapidity of these changes will be modified by circumstances, elsewhere stated. Observations of this kind often lead to useful results when proper caution has been taken. The appearance of a contusion inflicted recently before death, and of another inflicted some days before, is of course different, and by an appreciation of this difference, a person charged with murder may or may not be connected with one or the other period of infliction, or with both. In a case of alleged manslaughter, in which I was consulted some time since, there were found on the person of the deceased, the wife of a mechanic, the marks of severe bruises; some of them in the immediate neighbourhood of each other, had the rings of colour peculiar to a disappearing ecchymosis, while the others had not. The man alleged in his defence that he had only struck his wife once, a few hours before her death, whereas the above medical facts proved not only that the deceased had been struck more than once, but that some of the blows must have been inflicted probably several days before her death. These inferences were corroborated by the evidence of an apprentice who had witnessed the assaults. Such is an outline of the facts which may occasionally enable us to say how long before death particular injuries have been received; or to assign a probable period for their infliction on the living. By them we may be able to determine, whether two wounds found on a dead body were or were not inflicted at or about the same time. The law in these cases seldom requires a very close medical opinion; indeed this it would be scarcely possible to give under any circumstances. If a medical witness can only state, about what time the injury was inflicted, circumstantial evidence will make up for the want of great medical precision or accuracy on the point.

How long did the deceased survive?—This question, it will be perceived, is indirectly connected with the preceding, although sometimes put with an entirely different object. Supposing the wound not to have been such as to prove rapidly fatal, the length of time which

a person has survived its infliction, may be determined by noting whether it has undergone any changes towards healing, and in what degree. As a wound remains in the same state for about eight or ten hours after its production, it is not easy to say within this period how long the person may have survived. Then it has been supposed, that a medical opinion might always be formed from the nature of the injury, and the parts which it has involved. Thus, a wound may have involved large blood-vessels or organs important to life; in this case it is pretty certain that the individual must have died speedily. Let us, however, bear in mind, that these so-pronounced rapidly mortal wounds, do not often prove fatal for some hours or days; a fact which has been much overlooked by surgeons, although of considerable importance in relation to the medical jurisprudence of wounds.

Wounds of the carotid arteries are often pronounced *instantaneously* mortal. A witness may deliberately state that the person could not possibly have survived an instant. This is a very hazardous opinion, for it occasionally comes out on inquiry, that if such a wound were instantaneously mortal, then, in defiance of every rational probability, or of the strongest presumptive evidence to the contrary,—the deceased must have been murdered. A medical opinion of this kind has not only been refuted by circumstances, but by the evidence of eye-witnesses. The medical witness is then, perhaps, compelled to admit that his rules for judging of the mortality of wounds are wrong, and that the person may have survived for a longer or shorter period. Formerly it was the custom to say, that every penetrating wound of the heart was instantaneously mortal, and that the person must have dropped down dead on the spot; but more accurate observations have shown that this is an erroneous, and in medico-legal practice, a highly dangerous doctrine. If a man were found dead, and on inspection it was ascertained that he had been stabbed through the left ventricle of the heart, it would probably be said in answer to a question relative to survivorship, that he must have died instantly. Yet it is well known that the Duke de Berri, who was murdered in Paris in 1820, survived eight hours after having received a wound of this description. Other and more remarkable instances of survivorship will be adduced hereafter; in the meantime it may be stated that, although in a surgical view, a question of this kind is of little importance, the case is very different in legal medicine. Upon it may depend the decision of questions relative to suicide, murder, or justifiable homicide.

These observations apply with great force to injuries of the head. Cases have been frequently brought into Guy's Hospital, where a patient who had received a blow on the head has survived several hours or days; and after death, such injury to the cranium has been found, as would, if the person had only been seen when dead, have probably given rise to a medical opinion, that he must have died instantly. On the other hand, a person may fall lifeless from a blow which would produce no appreciable physical changes in the cranium or its contents; yet in this case, if the facts had been unknown, it

would have been said the person might have survived some hours or days. Thus, then, we see that it is by no means easy to determine, from an examination of a wound in a dead body, how long the person actually lived after its infliction. I do not say that an opinion on this subject is never to be expressed from the nature and extent of an injury, but what should be impressed upon a medical jurist is, that it must not be hastily given; for a groundless suspicion of murder may be thereby excited against some innocent person. A wound may be mortal, but it by no means follows that it should have destroyed life instantaneously. As an illustration of the evil results of the practice of giving these hasty judicial opinions, I may take a case which to my knowledge has occurred twice under almost similar circumstances. A man is found dead in his chamber with his throat cut, and the incision is found to involve one or both carotid arteries. The medical inference is that he must have fallen dead on the spot, and that he could not have survived an instant. If this be true, the weapon ought, of course, to be found either in the hand of the deceased or close to his body; but it is lying in another room, and there are marks of blood between the two rooms. What then is the conclusion? Either that the medical opinion is erroneous, and the deceased could not have dropped down dead instantly; or that he must have been murdered. This is, of course, a serious alternative; and unless circumstances tend to expose the error of the medical statement, irreparable injury may be done to an innocent person. The medical opinion has always given way when circumstances refuting it appeared; but it is the duty of a medical jurist to profit by such errors,—to apply his opinions with greater caution to similar cases, and not wait for their refutation by incontrovertible facts.

CHAPTER XXXIII.

ACTS INDICATIVE OF VOLITION AND LOCOMOTION IN PERSONS MORTALLY WOUNDED.

This question is immediately connected with those considered in the preceding chapter. It is often a matter of serious inquiry, whether a person can perform certain actions, or move after receiving a wound which is commonly regarded as necessarily mortal, and likely to destroy life speedily. In respect to wounds of a less grave description, if we except those affecting the members directly, which will be hereafter examined, the power of willing and moving in the person who has received them, cannot be disputed. The best way of treating this subject will be, perhaps, to select a few cases of severe injuries to important parts or organs, which are usually considered to destroy life speedily.

The question relative to the power of exercising volition and loco-

motion, has been chiefly confined to those cases in which there were injuries to the head, wounds of the heart, the large bloodvessels, the diaphragm and bladder. The following case occurred a few years since in the Norfolk and Norwich Hospital: A boy, owing to the bursting of a gun, had the breech-pin lodged in his forehead. He got out of a cart, in which he had been brought from a distance of four or five miles, and walked into the hospital without assistance. The pin was firmly impacted in the frontal bone about the situation of the longitudinal sinus. On its removal, a portion of brain came away with several pieces of bone, and the aperture in the cranium was nearly an inch in diameter. Symptoms of coma then came on, and the boy died in forty-eight hours. The brain was found to be considerably injured. (Med. Gaz. xviii. 458.)

Mr. Watson mentions a similar case. (On Homicide, 62.) And Dr. Wallace, of Dublin, another. (Lancet, April 1836.) See also Med. Gaz. xxxvi. p. 38. The medical opinion in an abstract question of this kind, is commonly based on individual experience; but the question really is, not whether the witness may himself have seen such a case, but whether such a condition of things is possible. If all opinions in a Court of law were to be founded on individual experience, many medical facts important either to the prosecution or defence, would be lost, because the witness by mere accident might never have met with an instance which presented them. The importance of this question will be further seen by the following medico-legal case, reported by Dr. Wallace: A man was found dead in a stable, with a severe fracture of the temporal bone, which had caused the rupture of the middle meningeal artery. A companion was accused of having murdered him, but he alleged that the deceased had fallen from his horse the day before, and met with the accident. It appeared, however, that after the fall, the deceased had gone into a public-house before he returned to the stables, and remained there some time drinking. The question respecting the guilt of the accused party rested upon the fact, whether, after such an extensive fracture of the skull with extravasation of blood, it was possible for a man to do what the prisoner had represented the deceased to have done. Dr. Wallace gave, very properly, a qualified opinion; he said it was improbable but not impossible, that the deceased could, after receiving such an injury, have gone and drunk at a public-house. The extravasation was here the immediate cause of death, and probably this did not take place to the full extent until after the excitement from drink. It is easy to conceive many cases in which this question will be of material importance. For instance, a man may fall from a height and produce a severe compound fracture of the skull. He may, nevertheless, be able to rise and walk some distance before he falls dead. Under these circumstances there might be a strong disposition to assert, that the deceased must have been murdered:—the injuries being such that they could not have been produced by himself, there being at the same time no weapon near, and no height from which it might be supposed that he had fallen.

Wounds of the heart were formerly considered to be immediately fatal to life, but this only applies to those wounds whereby the cavities of the organ are extensively laid open. Persons who have sustained wounds of the heart, have frequently lived sufficiently long to exercise the powers of volition and locomotion. Mr. Watson met with a case where a man who had been stabbed in the right ventricle, ran eighteen yards after having received the wound. He then fell, but was not again able to rise; he died in six hours. On dissection, it was found that a punctured wound had extended into the right ventricle in an obliquely transverse direction, dividing in its course the coronary artery. The pericardium was nearly filled with blood, and about four pounds were extravasated on the left side of the thorax. (On Homicide, 98.) One of the most remarkable instances of the preservation of volition and locomotion after a severe wound of the heart, will be found reported in the Medical Gazette, (xiv. 344.)

In these cases, little or no blood probably escapes in the first instance, but it may afterwards continue to ooze gently, or suddenly burst out in fatal quantity. It must not, therefore, be supposed when a person is found dead, with a wound of the heart, attended with abundant hæmorrhage, either that the flow of blood took place in an instant or that the person died immediately and was utterly incapable of exercising any voluntary power. Only one circumstance will justify a supposition of this kind; namely, where the cavities of the organ, more especially the auricles, are largely laid open. The following case reported by one of the editors of Beck's Medical Jurisprudence, will show the importance of this medico-legal question. It was here material to the defence of the prisoner.

The keeper of a brothel was tried in Glasgow, in the year 1819, for the murder of a sailor, by shooting him through the chest. It appeared from the evidence of the medical witnesses that the auricles and part of the aorta next the heart, were "shattered to atoms," by the slugs and brass nails with which the piece was charged; and in their opinion, the deceased must have dropped down dead on the moment that he received the shot. The body was found in the street, and the door of the prisoner's house was *eighteen feet* up an entry: so that it followed, if the medical opinion were correct, that the prisoner must have run after the deceased, and have shot him in the street. For the prisoner it was urged and proved, that he had shot the deceased through the door of his own house, which the latter was attempting to enter by force. Besides direct testimony to this effect from those within the house, and from a lad who was with the deceased at the time, it was proved that there was a stream of blood from the door of the house to the spot where the body lay, which could not have flowed from the body towards the house, as the threshold of the door was on a higher level than the pavement of the street. On this evidence, the prisoner was acquitted. If, by the heart being "shattered to atoms," we are to understand that its cavities were entirely laid open, and its substance destroyed, we have a description of wound which most professional men would not hesitate to pronounce instantaneously mortal. Although nothing is stated on the point, yet we must suppose it was proved, before the question of survivorship was raised, that the body of the deceased could not have been dragged after death from the door of the prisoner's house, to the spot where it was found; a circumstance which would have sufficed to account for the presence of a stream of blood, notwithstanding

the difference of level between the street and the door of the house. The question was of importance to the prisoner, inasmuch, as if he had shot the deceased while the latter was endeavouring to break into his house, the homicide might have been regarded as excusable; but, if after the deceased had left the house, he had run into the street and shot him, then probably this would have been considered sufficient evidence of malice to have justified a verdict of wilful murder. The jury adopted the first view of the case; and, therefore, found that the deceased had actually run into the street, after having been shot through the door of the prisoner's house.

Questions relative to the power of locomotion, perhaps more frequently occur with respect to wounds of the great blood-vessels of the neck, than of the heart,—suicide and murder being more commonly perpetrated by this means.

This question became a subject of judicial examination, in the case of the *King against Danks,* which was tried at the Warwick Lent Assizes, 1832. The prisoner was charged with the murder of a female by cutting her throat. It was found on inspection that the trunk of the carotid artery, and all the principal branches of the external carotid, with the jugular veins on one side, had been completely cut through. The evidence for the prosecution established clearly that notwithstanding this wound, the deceased had survived sufficiently long to get over a gate and run twenty-three yards on a high road before she dropped dead! (Med. Gaz. x. 183.) There is one circumstance which requires to be mentioned in relation to severe wounds in the *throat,* namely, that although the individual may have the power of locomotion, he may not be able to use his voice so as to call for assistance. It sometimes excites surprise at an inquest, how a murder may in this way be committed without persons in an adjoining room hearing any noise;—but the fact is well known medically, that when the trachea is divided, as it frequently is on these occasions, the voice is lost. A rupture of the *diaphragm* has been considered sufficient to deprive a person of the power of locomotion:—but there appears to be no good ground for this opinion. The general effect of such an accident may be to incapacitate a person; but the question is put to a medical jurist, as to the possibility of a wounded party being able to move after the injury. In the following case, reported by Devergie, the answer was material:—An intoxicated man, after having been maltreated by another, returned home, walking for at least two hours with two companions. The man died in fifteen hours; and, on inspection, among other severe injuries, there was found a recent longitudinal rupture of the diaphragm about two inches and a half in extent, and the stomach protruded through the aperture. The question was,—When could this rupture have taken place, for it was undoubtedly the cause of death? Was it possible for a person, with a recent rupture of the diaphragm, to walk for two hours? If this power of locomotion were admitted, then it followed that it might have been caused by the man who first ill-treated the deceased;—if not, then that the injury had been probably caused by the deceased's two companions, for it did not appear that he had been in company

with any other person. The medical witness admitted the possibility of the deceased being able to walk under the circumstances, but he thought it very improbable. There was not the smallest evidence to show that the deceased had been attacked or beaten by his two companions in journeying homewards; and, therefore, there could be no just reason for inferring their guilt, simply because locomotion after such an injury was something unusual as a matter of medical experience.

In ruptures of the *bladder*, attended with extravasation of urine, the same question as to the existence of a power of locomotion, has arisen. By the answer to this, we may sometimes determine whether the rupture was the result of homicide or accident. The following cases will show that this power does exist in some instances, although the general result is perhaps to incapacitate the individual from moving. A man, aged thirty-one, while intoxicated, received a blow on the lower part of his abdomen. He was sobered by the accident, and walked home a distance of a quarter of a mile, although suffering the greatest agony. When seen in the evening, twelve ounces of bloody urine were drawn off by a catheter, and he complained of having felt cold immediately after he had received the blow. He died four days after the accident. On inspection, there was no mark of bruise or ecchymosis on any part of the abdomen. The bladder was ruptured in its upper and posterior portion for about an inch. (Lancet, May 14, 1842.) The second case was related to me by a pupil. A gentleman who had been compelled to retain his urine, fell accidentally in descending a staircase, with the lower part of his abdomen against the edge of one of the steps. The sense of fulness in his bladder immediately ceased, and he walked to a friend's house to dinner. The nature of the accident was mentioned to a surgeon there present, who immediately suspected that the bladder must have become ruptured. This case terminated fatally in twenty-four hours. Thus then, from these two instances, it is evident that locomotion and muscular exertion may take place after an accident of this description. The medico-legal relations of this subject will be apparent from the following case, reported by Mr. Syme. A man passed some hours convivially with a few friends, after which a quarrel ensued, blows were exchanged, and the parties wrestled with each other. The deceased then walked home, a distance of more than a mile; and in crossing the threshold of his own door, he fell forwards on his abdomen. When lifted up, he complained of great pain, and was put to bed, being quite unable to exert himself. He died in two days, and upon dissection the bladder was found ruptured at its fundus to the extent of between two and three inches. Under these circumstances it became a question whether the rupture was caused by the violence of his companions, or by the accidental fall at the door of his own house. If by his companions, he must have walked more than a mile with his bladder ruptured; but two medical witnesses declared that he could not have walked this distance after the rupture, and consequently that it must have been occasioned by the subsequent fall. The symptoms of rup-

ture and extravasation occurring immediately after the fall, rendered it highly probable that this was really the cause. At the same time it is obvious that the power of locomotion may be exerted under such circumstances, to a much greater extent than is commonly supposed.

Under many severe accidents, this power of moving, if not exerted to a large extent, may take place in a small degree, and this is occasionally an important question in legal medicine. Thus it must not be lost sight of, when we are drawing inferences as to the relative position of a murderer and a murdered person from the situation in which the body of the deceased is found. A dead man, with a mortal injury to the head or heart, may be found lying on his face, when he actually fell upon his back, but still had had sufficient power to turn over before death, or he may have fallen on his face, and have afterwards moved, so that the body may be found lying on the back. A slight motion of this kind is very easily executed,—it does not always depend on volition. Individuals suffering under severe concussion, have been frequently known to perform acts unconsciously and automatically. The foregoing cases may perhaps be considered rare and as exceptions to the general rule. The medical jurist must bear in mind, however, that he is not required to state in how many out of a given number of individuals similarly wounded, this power of performing acts indicative of volition and locomotion may remain; but simply whether the performance of these acts be or be not *possible*. It is on this point only, that the law requires information. The hypothesis of guilt, when we are compelled to judge from circumstances in an unknown case, can only be received by an exclusion of every other possible explanation of the facts. As a matter for surgical prognosis or treatment, such cases, from their rare occurrence, may have little influence; but in legal medicine, the question is widely different. Facts, however rare, here admit of a very important and unexpected application. Although in cases of severe wounds, we may allow it to be possible that persons should survive for a sufficiently long period to perform ordinary acts of volition and locomotion, yet the presence of a mortal wound, especially when liable to be accompanied by great hæmorrhage, must prevent all struggling or violent exertion on the part of the wounded person,—such exertion we must consider to be quite incompatible with his condition. In this way, a medical jurist may be sometimes able to determine whether a mortal wound found on the deceased, has been inflicted for the purpose of murder, or in self-defence, as the following case, reported by Mr. Watson, will show. A man was tried at the Lancaster Assizes in 1834, for the murder of a woman at Liverpool, by stabbing her in the chest. Prisoner and the deceased, with two other females, were quarreling in the passage of a house. A struggle ensued between the prisoner and deceased, which one of the witnesses said lasted for ten minutes. When the prisoner had reached the door, he pulled out a knife and stabbed the deceased in the chest. She fell and died almost immediately. The prisoner alleged that he was attacked by several persons, and that he stabbed

the woman in self-defence. The judge said, if the blow had been struck with premeditation before the struggle, the crime would be murder;—if during the struggle it would be manslaughter. The medical evidence showed that the blow could not have been struck before the struggle, because it was of a speedily mortal nature, and the deceased would not then have been able, as it was deposed to by the witnesses, to struggle and exert her strength with the prisoner for *ten minutes* afterwards. This being the case, it followed that in all medical probability the deceased actually received the blow towards the conclusion of the quarrel; and therefore it might have been inflicted while the prisoner was attempting to defend himself. The jury returned a verdict of manslaughter.

CHAPTER XXXIV.

ON WOUNDS AS THEY AFFECT DIFFERENT PARTS OF THE BODY.

THERE are numerous medico-legal questions connected with wounds, as they affect different parts of the body, which now call for examination. It will not be necessary to enter into any surgical details respecting them; but an investigation of the symptoms caused by wounds of different structures, is of importance in legal medicine. It is only by attention to these that a correct prognosis can be given; and, when death is not a speedy result, the treatment of a prisoner by a magistrate, will materially depend upon the prognosis of the medical practitioner. By far the most important questions arise where death has taken place after a severe injury, but under circumstances which render it doubtful whether the fatal event can be fairly ascribed to the injury or not. This subject has been already considered in relation to wounds in general; but it was then impossible to specify all the modifications that are liable to present themselves according to the particular part of the body affected. The *danger* of wounds, and their *influence in causing death*, are the two principal points to which the attention of a medical jurist must be directed.

WOUNDS OF THE HEAD.—Incised wounds, affecting the scalp, rarely produce any serious effects, but this will, of course, depend on their extent. When the wound is contused, and accompanied by much laceration of the integuments, it is highly dangerous, in consequence of the tendency which the inflammatory process has, to assume an erysipela-

tous character. The results of these wounds are, however, often such as to set all general rules of prognosis at defiance. Slight punctured wounds will sometimes terminate fatally in consequence of inflammation being set up in the tendon of the occipito-frontalis, followed by extensive suppuration beneath; while, on the other hand, a man will recover from a lacerated wound by which the greater part of the integuments may have been stripped from the bone. There are two sources of danger in wounds of the scalp: 1. The access of erysipelatous inflammation. 2. Inflammation of the occipito-frontalis tendon, followed or not by the process of suppuration. Either of these secondary effects may operate fatally in slight or severe wounds. Neither can be regarded in the light of an unusual consequence of a severe wound of the scalp: but when one or the other follows a very slight injury, there is reason to suspect that the patient may have been constitutionally predisposed; and if fatal effects follow, the influence of this predisposition may be considered as a mitigatory circumstance. Bad treatment may likewise lead to a fatal result from a wound, not regarded as serious in the first instance; but how far the responsibility of the aggressor would be affected by a circumstance of this nature, has been treated of in another place. (p. 347.) Wounds of the head are dangerous, in proportion as they affect the brain; and it is rare that a severe contused wound is unaccompanied by some injury to that organ. There is, however, a difficulty which the practitioner has here to contend with, namely: that it is scarcely possible to predict from the external wound, the degree of mischief which has been produced internally. These injuries, as it is well known, are very capricious in their after-effects: the slightest contusions will be attended with fatal consequences, while fractures, accompanied by great depression of bone, and an absolute loss of substance of the brain, are sometimes followed by perfect recovery. Another difficulty in the way of forming a correct prognosis, consists in the fact, that an individual will recover from the first effects of an injury, but after a short time, he will suddenly die; and on examination of the body, the greater part of the brain will be found destroyed by the suppurative process, although no symptoms of mischief may have manifested themselves until within a few hours of death.

Concussion.—The common effect of a violent contusion on the head is to produce concussion or extravasation of blood, or both. In concussion, the symptoms come on at once, and the patient, if severely affected, sometimes dies without any tendency to reaction manifesting itself. But the period at which death takes place is liable to vary: a man may die on the spot, or he may linger in a state of insensibility several days, and in either case, after death, no particular morbid change may be discovered; there may be simply abrasion of the skin. In the case of *Reg.* v. *Burgess,* Liverpool Lent Assizes, 1845, the deceased fell and died on the spot, and there was no lesion externally or internally. The state of insensibility observed in concussion, is

sometimes only apparent. Mr. Guthrie relates the case of a gentleman who while lying apparently deprived of sense and motion, and supposed to be dying, heard a discussion between a relative and another person, as to how they should dispose of his body, and he was conscious of his utter inability to make any movement, indicating that he was alive and understood their conversation. Inflammation may supervene after the primary shock, suppuration will take place, and the patient die after the lapse of some weeks or even months. It is important in a medico-legal view to notice, that an individual may move about and occupy himself, while apparently convalescent, for a week or ten days after recovery from the first shock, and then suddenly be seized with fatal symptoms and die. This apparent recovery leads to the common supposition, that death must have been produced by some intervening cause, and not by violence to the head, —a point generally urged in the defence of such cases. When the inflammation that follows concussion is of a chronic character, the person may suffer from pain in the head and vomiting, and die after the lapse of weeks, months, or even years (ante, p. 346, case by Sir A. Cooper.) A case is mentioned by Hoffbauer, where the person died from the effects of concussion of the brain, as the result of an injury received eleven years before. (Ueber die Kopfverletzungen 57, 1842.) Concussion may sometimes take place as a consequence of a violent fall on the feet, in which case the head receives a shock through the medium of the spinal column. The brain may be even shattered by such a fall. This was the cause of death in the late Duke of Orleans. —See Med. Gazette, xxxvi. p. 368.

The symptoms under which a wounded person is labouring, may be sometimes attributed to *intoxication*, and a medical witness may be asked what difference exists between this state and that of concussion. The history of the case will suffice to establish a distinction, but this cannot always be obtained. It is commonly said that the odour of the breath will detect intoxication; but it is obvious that a man may meet with concussion after having drunk liquor insufficient to cause intoxication, or concussion might take place while he is intoxicated, a combination which frequently occurs. Under such circumstances, we must wait for time to develope the real nature of the case; but concussion may be so slight, as sometimes closely to resemble intoxication; and in the absence of all marks of violence to the head and the existence of a spirituous odour in the breath, the medical examiner might be easily deceived. On the other hand, intoxication may be so great as to give rise to the apprehension of fatal consequences, and the co-existence of a mark of violence on the head, might lead to error in the formation of an opinion. What is the line of conduct to be pursued on such occasions? The examiner should weigh all the circumstances, and if there be one cause for the symptoms more probable than another, he should adopt it:—if there be any doubt this should be stated to the Court.

Extravasation of blood.—A blow on the head may destroy life by causing an extravasation of blood on the surface, or in the substance of the brain. This subject has very important applications in legal medicine, for this is one of the most common causes of death in injuries to the head, and there are generally many cases of this description tried at every assizes. Extravasation may occur from violence, with or without fracture, and it may take place without there being any external marks of injury to the head. In the case of the *Queen against Phelps* and others, Gloucester Aut. Ass. 1841, it was proved that there was great effusion of blood, and even laceration of the brain in the deceased, without any corresponding external injuries. Also at the same assizes, in the case of the *Queen against Thomas.* (p. 340.) The chief source of the effusion in violence to the head, arises from the rupture of the meningeal artery, and this may occur from the mere shock or concussion, with or without a fracture of its bony canal. The blood thus effused acts by compressing the brain; this compression does not always cause death unless the blood be in large quantity, or unless it be effused in or around the medulla oblongata. The hemispheres will bear a degree of compression which would destroy life instantly, if it affected that portion of the base of the brain from which the spinal marrow proceeds. The most fatal effusions, therefore, are those which take place in a fracture of the base of the skull, whereby one or both lateral sinuses are commonly ruptured.

In cases of injuries to the head proving fatal by *extravasation* of blood on the brain, an individual may recover from the first effects of the violence, and apparently be going on well, when he will suddenly become worse and die. Extravasation takes place slowly at first,—it may be arrested by the effects of stupor from concussion, by a portion of the blood coagulating around the ruptured orifices of the vessels, or by some other mechanical impediment to its escape; but after a longer or shorter period, especially if the individual be excited or disturbed, the hæmorrhage will recur and destroy life by producing compression. How many hours or days, after an accident, are required in order that such an increased effusion should take place, it is impossible to say; but in severe cases, fatal extravasation is observed to follow the injury within a very short time. Sir Astley Cooper relates the case of a gentleman who was thrown out of a chaise, and fell upon his head with such violence, as to stun him in the first instance. After a short time he recovered his senses, and felt so much better, that he entered the chaise again, and was driven to his father's house by a companion. He attempted to pass off the accident as of a trivial nature, but he soon began to feel heavy and drowsy, so that he was obliged to go to bed. His symptoms became more alarming, and he died in about an hour,—as it afterwards appeared, from extravasation of blood on the brain.

Blood may be found extravasated in various situations within the interior of the cranium: and the cause of the extravasation may be either disease or violence. The skill of a medical jurist is often re-

quired to determine which of these causes is the more probable, as where, for instance, a pugilist has died after having received severe injuries to the head, and his adversary is tried on a charge of manslaughter. On these occasions, it is often urged in the defence, that the fatal hæmorrhage might have arisen either from a diseased state of the vessels of the brain; or, if the evidence render it probable that the blow was the cause, that the effects of the blow were aggravated by a diseased state of the vessels, or by the excitement into which the deceased was thrown, either from the effects of intoxication or passion. When the brain is not lacerated by the violence, the blood is effused on the surface of or between the membranes or at the base. It is not always seen under the spot where the blow was inflicted, but often by counter-stroke on the surface of the brain, directly opposite to it;—a case which a medical witness has frequently had to explain on trials, and which depends on the same cause as fracture by counterstroke, to be hereafter spoken of. (See case by Dr. Haworth, Med. Gaz. xxxvi. 368.) Effusions of blood from a diseased state of the vessels, more commonly take place in the substance of the brain, but they sometimes occur on the surface of the organ from mere excitement or over-exertion of the muscular powers. In a case which occurred in 1840, a boy, aged twelve, died suddenly, with comatose symptoms, after violent exertion. On inspection, half a pint of blood was found effused on the surface of the brain. (Lancet, Nov. 1840.) This case is the more remarkable, because it is rare that spontaneous effusions from disease should occur in so young a subject. Then again it must be remembered, that under the effects of violence where the brain participates in the injury, blood may be effused in its substance so as to resemble cerebral hæmorrhage from disease. Thus when the skull has sustained violent blows without fracture, the extravasated blood has been observed to proceed from the minute vessels of the pia mater and choroid plexus. A singular case is reported (Lancet, Jan. 11, 1845, p. 51.), where a blow on the *neck* over the *jugular vein* caused death apparently from effusion of blood in the brain. The death was instantaneous. Another fatal case from the same cause is referred to, in which a large quantity of blood was found effused in the lateral ventricles. Dr. Traill mentions an instance which occurred at Liverpool, in 1838, in which a blow with the naked fist entirely divided the external carotid artery in a healthy man, who died very speedily. (Outlines, 89.)

If the effusion depend on *disease*, the arteries around may be found in a diseased condition, or the brain itself may be found softened and disorganized. The state of the brain and its vessels should be closely examined in all cases of alleged violence; since hæmorrhage may take place from excitement, or slight blows, whenever this diseased condition exists. It has occasionally happened, but more especially in old persons, that the individual has dropped down dead without a blow being struck, and that death had been wrongly imputed to violence. Cerebral hæmorrhage from disease rarely occurs in persons under forty

years of age. Frequent intemperance and violent passion may however easily create a tendency to it in younger subjects. As an effect of violence it may take place in persons of all ages. For a very full account of the circumstances accompanying extravasation from violence, see Brach's Chirurgia Forensis Specialis, p. 63. Köln, 1843.

Another condition besides intoxication and passion has been said to favour a rupture of vessels and an effusion of blood on the brain,—namely, a thickened state of the parietes of the left ventricle of the heart. According to some pathologists, this morbid condition favours the occurrence of cerebral hæmorrhage, by the force with which the ventricle propels the blood to that organ. Unless the brain be softened and the vessels diseased, it is very doubtful whether this condition of the heart would have much influence.

As a summary of these remarks, we may say that in extravasations from violence, the blood generally issues from a vessel which is plainly seen to be torn, as the middle meningeal artery or lateral sinus:—it is commonly found on the surface of the brain, and not in its substance, unless the organ be lacerated. When placed between the dura mater and skull, more especially when immediately below the seat of violence, or directly opposite to it by counterstroke; this is strong evidence, cæteris paribus, that it has proceeded from a blow. When there is a fracture of the skull, the presumption of the extravasation being due to violence is great; because this is not only a sufficient, but a very obvious cause, while the idea of its having proceeded from disease only, is remote and speculative. When, besides these points, there is no remarkable congestion of the brain in other spots,—the substance of the organ is firm, and the vessels are, to all appearance, free from disease, we have the strongest reason to presume, that the extravasation must have been due to violence, and to no other cause whatever.

The evidence given on some trials, where the main question has turned upon the cause of an extravasation of blood in a person who has sustained violent injuries to the head, has rather tended to reflect disgrace on medical science. It has been made to appear, either directly or by implication, that no sort of mechanical violence applied to the head of a man in a state of drunkenness or passion,—of one whose cerebral vessels were probably diseased,—or the parietes of whose heart might be thickened,—could have had any effect in producing the fatal extravasation found in the head after death. In spite of an individual having received a violent blow with a bludgeon, sufficient to have killed a stout and vigorous man,—or of his having been thrown with considerable force with his head against a stone floor, an unrestricted admission is often made, that excitement alone, or drunkenness alone, would account for the extravasation without reference to the blow. In putting the most favourable construction upon these cases, when we have clear evidence of some violence having been used to the head with the presence of the usual post-mortem appearances, our opinion should be that the excitement or drunkenness had predisposed to, but was not

the immediate cause of the cerebral hæmorrhage. There seems to be no good reason for assuming that apoplexy from natural causes always occurs, by a peculiar coincidence, just at the time that a person receives a violent blow with a bludgeon on the head, or for giving to the assailant, the benefit of this hypothetical explanation.

When engaged in the investigation of a case of this kind, it is always a fair matter of inquiry, whether the violence, upon the evidence, was not of itself sufficiently great to account for the extravasation of blood without the supposition of co-existing disease or excitement. Even if it be admitted, that the rupture of a blood-vessel and extensive extravasation on the brain may take place from simple excitement and passion; yet this is an event comparatively rare, at least in the young and healthy, while nothing is more common than that these effects should follow violent injuries to the head, whatever the age or condition of the person. The medical witness should remember that, on these occasions, if he is unable to say positively whether the extravasation were due to the excitement or the blows, he will satisfy the Court if he only state clearly that which is, in his own mind, the more probable cause: and by weighing all the circumstances of the case accurately before-hand, he will scarcely fail to find, at least in many instances, that one cause was more probable than the other. Thus, if a man, excited by passion and intoxication, is struck on the head, and the blow is very slight,—such as an unaffected person would probably have sustained without injury; yet in this case insensibility and death follow, and, on examination, a quantity of blood is found extravasated in the substance of the brain,—Can it be a matter of doubt with the practitioner, that the extravasation was chiefly due to the excitement under which the deceased was labouring? To take a converse instance,—a man, moderately excited in a personal conflict with another, is struck most violently on the head, or falls with great force on that part of the body,—this is followed by fatal extravasation on the surface of the brain, and it would be no unexpected consequence of such violence that a similar appearance should be met with in an individual calm and unexcited,—Can the practitioner hesitate to say that, in this instance, the blow would satisfactorily account for the extravasation, without reference to any co-existing causes of excitement? These may be allowed to have their influence in giving an increased tendency to cerebral hæmorrhage or in aggravating the consequences of the blow, but no further.

In these criminal investigations, when a witness is examined in chief, he asserts, perhaps, that the extravasation of blood was owing to the blow inflicted on the head. He is then asked by the counsel who cross-examines him, whether vessels may not be ruptured by excitement: he answers at once in the affirmative, thus unconsciously producing an impression on the minds of the jury, that excitement may have caused the rupture of the vessel in the particular case on which he is being examined. This is precisely the sort of answer which a prisoner's counsel wishes to extract from a witness; and the effect

produced by it on the Court, may not be always removed, even by a careful re-examination. The counsel for the defence is well aware that, in a case of this description, his only chance of obtaining an acquittal, is to throw a degree of doubt on the medical evidence; and to render it probable to a jury, that the death of the deceased party was due to some other cause than the blow inflicted by the prisoner. It may be very proper that a skilful barrister should exercise his talents in this way, but it is at the same time right that a medical witness should be prepared for the kind of examination which he is about to undergo. The manner in which it appears to me, a witness so situated should conduct himself, is, that he should give a qualified answer to what is really a general question; and, supposing his opinion to be already formed on the subject on which he is giving evidence, he should not, unless it be strictly consistent with his own views, allow his answer to a *general* question to be made applicable to a *particular* case. If then asked, in cross-examination, whether vessels might not be ruptured and blood extravasated by excitement, he should answer that such an effect might undoubtedly follow: but that it was his opinion,—and I am here supposing that this opinion has been founded upon a deliberate examination of all the *medical* facts,—that excitement was not the cause of rupture and extravasation in the case in question. A witness has, it appears to me, a right to insist that his evidence shall pass to the jury without having any designed ambiguity attached to it. It may be said that the remedy for an evil of this kind is the re-examination of the witness; but I am satisfied from the reports of many cases before me, that the point is often overlooked. Besides one cannot understand why a piece of sophistry and equivocation is to be left to a chance exposure:—the case would then rest not upon sound medical evidence, but upon the relative degree of ingenuity and ability displayed by the counsel for the prosecution and defence. In a trial for manslaughter which took place some years since at Derby, it was proved that the prisoner and deceased had been wrestling. The prisoner had thrown the deceased with his head on a stone floor; he then seized him by the throat, and beat his head several times against the floor. The deceased died nineteen hours afterwards. On inspecting the body, a great quantity of coagulated blood was found beneath the scalp. There was a wound over the right parietal bone, an inch and a half in length, penetrating through the scalp; but no fracture of the skull. There was a quantity of extravasated blood on the opposite or left side of the head; and a rupture of some branches of the carotid artery on the inside of the skull. On the neck were two discolorations to the left of the trachea, apparently occasioned by the pressure of two fingers. The laying hold of the neck might, in the opinion of the witness, have more readily caused a rupture of the cerebral vessels, by preventing the return of blood. The surgeon, after giving this description of the post-mortem appearances, was asked whether, in his opinion, death was occasioned by the injury proved in evidence. He said death might or might not

have been occasioned by it. Death might have arisen from other causes,—an apoplectic fit might have occasioned it. The effusion of blood had occasioned death, and he had seen blood in the heads of many persons dying from apoplexy. The cause of death was the pressure of coagulated blood upon the brain. He was not able to speak to the cause of the rupture of the vessels. He thought it highly probable that the injury received was the cause of death,—it was certainly sufficient to account for it! The judge severely censured the witness, for not stating at once that he believed the injury was the cause of death. It is not mentioned whether the man was found guilty upon this evidence, or whether the jury acquitted him. (Med. Gaz. vii. 382.)

A case has recently been tried (*Reg.* v. *Phipps*, Gloucester Summer Ass. 1845,) in which a strong but very correct opinion was expressed by Mr. Justice Patteson, in relation to the defence adopted on these occasions. During a fight, the prisoner struck the deceased a severe blow under the left ear. He fell and died in a few minutes. After death, blood was found extravasated on the part corresponding to the seat of violence, and this in the opinion of the medical witness, satisfactorily accounted for death. The defence was, that the effusion might have proceeded from over-excitement; but the judge is reported to have said that if it were proved two people were fighting together—blows were struck—one fell to the ground and died, and afterwards internal injuries were found corresponding with the external marks of violence, no power on earth could persuade him that such blows were not the cause of death! The prisoner was found guilty.

Fractures.—A simple fracture of the skull is not of itself dangerous, where the bones have not been separated: but it is rare that a fracture of the bones of the cranium is witnessed, without being complicated with concussion, extravasation of blood, or subsequent inflammation internally, to either of which consequences the danger must be assigned. It is necessary to observe, that a fracture does not always take place at the spot which receives the blow: it is often seen in a distant part of the skull. Thus a blow on the vertex, when sufficiently severe to produce fracture, often causes the bones to separate at the base of the skull, rather than in the immediate neighbourhood of the spot where the violence was inflicted. These *counter-fractures*, as they have been called, are chiefly seen in cases in which the violence has been applied to the cranium, by a body presenting a large surface. They are almost always situated at a point diametrically opposite to the part struck. Thus a violent blow on the vertex causes fracture of the base, indicated by a discharge of blood from one or both ears, owing to a rupture of the lateral sinus. A blow on the occiput will sometimes cause a fracture of the middle and lower part of the frontal bone,—while a blow on the lateral and upper part of the head, may be followed by a fracture of the orbitar plate. This is owing to the physical law that the parts in which the force, applied to any hollow

dome, becomes concentrated, are diametrically opposite to each other. (See remarks on this subject by Dr. Haworth, Med. Gaz. xxxvi. 373.) A question arose in a recent case, whether a direct fracture on the part struck and a fracture by counterstroke, could be produced by a blow on one side of the skull. This does not appear possible, since the force in such a case, would be expended on the part directly struck. The existence of two fractures would therefore render it probable that two blows had been struck. Fractures of the skull, when accompanied by depression of bone, are usually attended with loss of consciousness and the power of moving; but when a portion of brain is lost, the depressed bone occupying the space of the cerebral substance which has escaped, does not always cause these symptoms. (See cases, antè, p. 368.) Such injuries are highly dangerous; but nevertheless there are extraordinary instances of recovery on record, even where there has been a considerable depression of bone, combined with a great loss of substance of the organ. Those fractures, which involve the base of the skull, are more commonly accompanied by extravasation of blood, than those which are produced in the upper arch of the cranium; and such extravasations, from the large size of the vessels, which are there situated, commonly terminate fatally within a very short period; internal hæmorrhage, however, is not always the cause of death in these severe injuries. Sir Astley Cooper has recorded the case of a female, in whom a fracture took place from the vertex through the sphenoid bone, owing to a shutter having fallen on her head. This woman had no comatose symptoms, and she died after a short time in consequence of inflammation occasioned by the irritation of the fracture. On dissection, the fracture was found to extend through the basis cranii, so that it divided the skull into two nearly equal portions. In a case, which has been reported by Sir Charles Bell, fracture of the base of the skull, produced death in a very singular manner several weeks after the accident. On a post-mortem examination, it was found that the fracture had rendered the border of the foramen magnum rough, and that a small projecting portion of bone, by a sudden turn of the head, had become forced into the spinal marrow and destroyed life.

A medical jurist must not forget, that fractures may take place internally without any breach of continuity being seen on the external parietes. Thus a blow on the skull may cause a fracture of the internal table, without producing any appearance of fissure or fracture externally. In other cases the whole substance of the skull may be fractured without a division of the skin, where the force is of a bruising kind. (*The Queen against Ward*, Cent. Crim. Court, 1841.) There is one remarkable circumstance connected with these fractures, accompanied by depression of bone, which here requires to be mentioned,—namely, that the person has been sensible so long as the foreign substance which produced the fracture and depression, remained wedged in the brain, and that insensibility and other fatal symptoms only began to manifest themselves after its removal. This being ad-

mitted, it may be urged in defence, that death was really caused by medical interference. But it is a sufficient answer to state, that the wounded person must have died from inflammation of the brain, if the foreign body had been allowed to remain; and that it is consistent with the soundest principles of practice, to remove all such foreign substances without delay. In fractures of the skull, with depression, it may become a question whether the surgeon raised the depressed portion of bone so soon as he ought to have done. (See case. Henke Zeitschrift der S. A. 1838. Erg. H. 230.)

Wounds of the BRAIN itself sometimes prove instantaneously mortal even when slight, while in other cases, recoveries take place from contused or punctured wounds of this organ, contrary to all expectation. When an individual survives the first effects of the injury, there are two sources of danger which await him: 1,—the production of fungus from the exposed portion of brain; and 2,—inflammation and its consequences. The process of inflammation, it must be remembered, is very slowly established in this organ: it may not manifest itself until from three to ten weeks after the injury.

THE FACE.—Wounds of the face are important on several accounts. When of any extent, they are usually followed by great deformity; and when penetrating the cavities, in which the organs of the senses are situated, they often prove fatal by involving the brain and its membranes, or by giving rise to inflammation in that organ. Wounds of the eye-brows are not always of so simple a nature, as might at first sight be supposed. Besides being attended by deformity when they heal, they are liable to give rise, during the process of healing, to serious disorders of the neighbouring parts. Amaurosis and neuralgia are recorded among the secondary and not unusual consequences of such wounds, when the supraorbitar nerve has become at all implicated. Under certain conditions of the system, there may be inflammation of the parts within the orbit, extending by contiguity to the membranes of the brain, and proving fatal by leading to the formation of matter within that organ. In a work recently published, an instance is recorded of the occurrence of amaurosis in the right eye, after a contused wound, not of a very violent nature, to the right eye-brow. Dr. Wallace of New York has reported two cases of amaurosis following blows over the infra-orbitar nerve. (Med. Gaz. xxxi. 931.) Wounds apparently confined to the external parts of the face, frequently conceal deep-seated mischief. A sharp instrument penetrating the eyelid, and passing upwards with any force, will produce fracture of the orbitar plate of the frontal bone, which is known to be extremely thin, and even injure the brain beyond.

In several instances in this country, trials for murder have taken place, in which death has been caused by a penetrating wound of the orbit, leading to fracture of the orbitar plate and injuring the brain. In the year 1735, the celebrated *Macklin*, the comedian, was tried for having caused the death of Thomas Hallam, by thrusting a stick into his eye. On inspecting the body of the deceased, it was ascertained that the stick had entered the brain; the prisoner

was found guilty of manslaughter. It is necessary for the witness to bear in mind, that such an injury may be produced by the application, comparatively speaking, of only a moderate degree of force. A somewhat similar case occurred at Liverpool, in February, 1843, where a boy killed another by wounding him with a gimlet in the eye. The brain was perforated, and he died in two days. The following instance, reported by Mr. Watson, will show what a very simple cause may produce a serious wound of this description. A boy, aged ten, had the birch end of a common broom, thrust several times into his face by one of his companions. He became stunned, and was carried home in a state of stupor. He afterwards complained of violent pain in the eyeball and forehead. Symptoms of inflammation and fever supervened, followed by coma, convulsions, and insensibility. He died in about sixteen days after the accident. On dissection, the orbitar plate was found perforated, and pus and lymph were effused at the base of the brain. The left ventricle contained three ounces of pus, and communicated with the wound in the orbit. A small portion of bone was partially separated from the orbitar plate, and projected upwards. For many similar cases, and one in which death took place in six hours, from a wound made by a tobacco-pipe, see Hoffbauer Ueber die Kopfverletzungen, p. 49, 1842. In infants and young children the partition between the orbit and the brain is almost membranous, and is therefore perforated by the slightest causes. A man was tried in Scotland, in 1827, for killing a girl, by shooting her. The prisoner had inadvertently discharged a gun towards the high road where the deceased was standing. She received the shot in her face, but the wounds appeared quite superficial. She died in three days, and it was found that one small pellet had penetrated the orbitar plate and perforated the brain. It would appear, from a case reported by Dr. Scott, that the orbitar plate need not always be perforated, in order that fatal inflammation of the brain should be set up. A deeply penetrating wound of the orbit only, has caused death under the usual symptoms of cerebral disturbance. (Ed. M. and S. J. xliii. 263.) For a remarkable case of wound of the brain through the orbit by Dr. Neumann, see Casper's Wochenshrift, May, 1845.

THE NOSE.—These wounds are, generally speaking, of a simple nature, rarely giving rise to serious symptoms, but they are almost always attended with great deformity. If the injury be contused and, at the same time, extensive, a loss of the faculty of smelling will probably result. A penetrating wound of the nose, produced by passing a sharp-pointed instrument up the nostril, may destroy life by perforating the cribriform plate of the ethmoid bone and injuring the brain. Such a wound, it is obvious, might be produced without leaving any external marks of injury. Dr. Corkindale, of Glasgow, met with a case in which a man died from the effects of a wound of the nose, whereby the nasal bones were fractured, nine weeks after the injury. On inspection there was copious inflammatory effusion at the surface of the brain, particularly at the part corresponding to the seat of the violence.

Wounds of the face, when at all extensive, are always followed in healing, by greater or less *deformity*. The medical witness may perhaps find these questions put to him in relation to them. Is the wound likely to be attended with deformity? Could such a wound of the face heal without deformity? or could the deformity, if it exist, have been produced by any other cause than the wound? These questions are of more importance than may at first sight appear. Thus a person may allege that he was severely wounded in the face, when the

medical witness on examination, may find no trace of such a wound as that described. Or a person may seek damages from another in a civil action, by alleging that a particular deformity was produced by a wound, when the medical witness may be able to trace its origin to disease.

A case in which these questions were raised, was referred to me under the following circumstances. Some of the particulars have been elsewhere stated. (antè, p. 305.) (The *Queen against Henry Reed and Elizabeth Donelan*, Chelmsford Spring assizes, 1842.) The medical evidence was to the effect, that "there was a wound on the nose of the prosecutrix, apparently inflicted by some sharp instrument, and the bridge of the nose was broken down. The weapon had entered half an inch, and had caused profuse bleeding. The wound was sufficiently deep, that if it had entered a little higher up in the eye, it might have caused death." In the defence, it was urged that no weapon had been used; and that although the male prisoner had struck the prosecutrix a blow, the female prisoner had taken no share in the assault. It does not appear that any medical evidence was called to show in what state the face of the prosecutrix was, at the time of the trial. It was assumed that a weapon must have been used, and the prisoners were convicted, the one of stabbing and the other of aiding and abetting. About six months after the alleged stabbing, and some weeks after the prisoners had been convicted and sentenced to punishment, the face of the prosecutrix was examined by two surgeons, (one of them a practitioner of twenty-eight years' standing,) and they both deposed that there was no mark of a cicatrix, of fracture of the nose or of any personal injury whatever. Other surgeons were requested to examine the face of the prosecutrix, but this she declined permitting; and as there was no power to compel her, the case was referred to Professor Quain, Mr. Guthrie, Mr. Key, and myself The evidence of the surgeon at the trial was laid before us with the statements of the two surgeons, who examined the prosecutrix afterwards. We all agreed that if such a wound as that described in the medical evidence had been inflicted, there would have been a visible scar and a ridge or prominence indicative of the situation where the bridge of the nose was stated to have been broken down: and as no such marks could be perceived by two well informed surgeons, we considered it improbable either that such a wound as that described could have been inflicted, or that a weapon could have been used in the assault. The question to be decided was—Could all traces of such a wound as that above described be effaced in a period of six months, or even during the life of a person? Either the wound must have been misdescribed, or some traces of it would unquestionably have been found.

Injuries to the spine.—Injuries to the spine and spinal marrow seldom require medico-legal investigation: but this organ is liable to concussion from blows, to compression from fracture of the vertebræ, or the effusion of blood, with all the secondary consequences attending such accidents. Concussion of the spinal marrow commonly produces paralysis: but the symptoms may be of a still more alarming kind; and after death no traces of mechanical injury may be discovered. Blows on the spine unattended with fracture or dislocation, may, according to the observations of Sir B. Brodie, be followed by inflammation and softening of the spinal marrow. A very slight injury has been known to cause death by giving rise to inflammation of the spinal marrow. (See Henke Zeitschrift, der S. A. 1840, ii. 407.) This organ is also liable to compression from very slight causes, as will be evident from the following medico legal case reported by Mr. King, of Glasgow.

A man was tried on a charge of manslaughter. It appeared in evidence that he had thrown deceased on the ground, and while he was attempting to rise he caught him by the throat, forcing him backwards, and bringing his head violently in contact with the ground. Deceased died after a few convulsive gasps. On inspection, the spinal cord was found to be compressed between the body of the fourth and the arch of the third vertebra, but on removing it, no indentation or laceration of its substance was perceptible. Death had ensued from paralysis of the phrenic nerves. It is remarkable that so slight a degree of violence should have caused so serious an injury, for the affair took place before eye-witnesses. This case shows the necessity of inspecting the vertebral column, when death is alleged to have been caused by violence and no traces of it are perceptible in other parts of the body. Indeed it is not improbable that in most cases of sudden death from alleged or suspected violence, where the cause is obscure, if the spinal marrow were examined, the fatal result might be explained by the discovery of some mechanical injury or morbid changes in this organ. This part of a medico-legal inspection is, however, commonly neglected.

Fractures of the vertebræ are generally attended by displacement and compression of the spinal marrow. They are the more rapidly fatal in proportion as the injury is high up in the vertebral column, the whole of the body being paralysed below. If the seat of compression be above the fourth cervical vertebra, death is commonly immediate. In falls on the vertex from a height it sometimes happens not only that the skull is extensively fractured but that the dentiform process of the second vertebra is broken off, owing to the head being doubled under the body. This might really be the cause of death From a case related by Mr. Phillips, it would appear that this acciden is not always attended by fatal compression of the spinal marrow (E. M. & S. J. Jan. 1838.) In a second case the individual survived fifteen months, ib. Oct. 1845, p. 527 ; and in a third, where the fracture was caused by the patient, turning in bed, while his head was pressed on the pillow, death did not take place for *sixteen* months. (Copland Dict. Pr. Med. Paralysis.) On several criminal trials this injury has been proved to have been the cause of death : and in a memorable case, tried at Glasgow, some years since, (the *King against Reid,*) it became a material question, how far an injury of this kind might result from disease. It may happen that caries of the bone or disease of the transverse ligament will cause a separation of the dentiform process from the second cervical vertebra. The state of the bone should, therefore, be closely examined. In Reid's case an acquittal took place, partly because the deceased had laboured under disease of the spine, and the exact state of the parts had not been noticed. Disease of the ligaments may also lead to a separation, and slow and rapid death, according to the degree of pressure. A case occurred not long since where a lunatic in a private asylum, suddenly threw her head back in order to avoid taking some food that was offered to her ; and she died evidently from the compression produced by the displacement of the dentiform process. A woman died suddenly a month after her confinement. She had been suckling her child at one o'clock in the morning, and at four she was found dead. The viscera of the abdomen, thorax, and head were carefully examined without finding anything to account for her death—when, as the brain

was being returned into the skull, Mr. J. Wilson noticed a projection at the foramen magnum. On examination, the dentiform process of the second vertebra was found to be luxated backwards: this had so injured the spinal marrow as to destroy life. (Med. Gaz. iii. 582.) It is not stated whether the parts were in a healthy or diseased condition. The following case shows that the rapidity of death will depend on the degree of compression. A girl had a stiff neck, as it was supposed, from cold. Her head was continually twisted to the left side, but she possessed the power of moving it in the opposite direction. While in this state a man suddenly seized her and gave her head a violent twist. She felt immediately a severe pain, lost the power of turning her head to the right, and had difficulty of swallowing. These symptoms continued to increase for a month, and she ultimately died under a paralytic affection. On inspection, the odontoid ligaments were found ruptured, but there was no mark of suppuration. The bones were healthy. The dentiform process had compressed the anterior columns of the spinal marrow, which were softened; it was observed during life, that she had lost more of the power of motion than of sensation. (Gaz. Médicale, Nov. 1842.)

Compression of the spinal marrow sometimes arises, though rarely, from *effusion* of blood produced by blows or falls—but it is important to remember, that these effusions may also take place from spontaneous causes. On an examination being made of the body of a person, who had died from an accidental fall, a coagulum of blood was found effused into the substance of the spinal marrow, exactly opposite a fracture of the body of the sixth cervical vertebra. Injuries to the spine and its contents, are generally the result of falls or blows either on the head or the lower part of the column. The secondary consequences are sometimes very insidious, so as to disarm suspicion, and death may take place quite unexpectedly some weeks after the accident. Spicula of bone separated by fractures, may remain adherent for some time; and by a sudden turn of the head, be forced off and destroy life by penetrating the spinal marrow, at a long period after the receipt of the injury. (See antè, case by Sir C. Bell.) This has been known to happen in fractures, involving the margin of the foramen magnum, and in such cases, death is immediate. The spinal marrow has been in some instances wounded in its upper part by sharp-pointed instruments introduced between the vertebræ. Death is an instantaneous result, when the wound is above the third cervical vertebra:—there is no part of the spine where a weapon can so readily penetrate as this, especially if the neck be bent forward. The external wound thus made may be very small and if produced with any obliquity by drawing aside the integuments, it might be easily overlooked, or it might be set down as superficial. For an account of a fatal stab in the back of the neck, leading to a division of the spinal marrow, see Henke Zeitschrift, der S. A. 1839. H. ii. 1836.

THE CHEST.—Wounds of the chest have been divided into those which

are confined to the parietes, and those which penetrate the cavity. The division is important, so far as it relates to the prognosis of such injuries. Incised or punctured wounds of the parietes of the chest are rarely followed by dangerous consequences. The hæmorrhage is not very considerable, and is generally arrested without much difficulty. They heal either by adhesion or suppuration, and unless their effects be aggravated by incidental circumstances, the prognosis is very favourable. Contusions or contused wounds of the thoracic parietes are, however, far more dangerous; and the danger is always in a ratio to the degree of violence used. Such injuries, when severe, are ordinarily accompanied by fractures of the ribs or sternum,—by a rupture of the viscera within the cavity, including the diaphragm,—by profuse hæmorrhage,—or, as an after-effect, by inflammation of the organs, with or without suppuration. Fractures of the ribs are dangerous for several reasons: the bones may be splintered and driven inwards, thereby wounding the lungs and causing hæmorrhage, or leading to inflammation of the pleura or lungs. In fractures of the upper ribs, the prognosis is less favourable than in those of the lower, because, commonly, a much greater degree of violence is required to produce the fracture. A simple fracture of the sternum, without displacement of the bone, is rarely attended with danger, unless the concussion has at the same time produced mischief internally, which will be known by the symptoms. When, however, the bone is depressed as well as fractured, the viscera behind may be mortally injured. In a case of depressed fracture of the sternum, recorded by M. Sanson, the individual died after the lapse of thirteen days; and on inspection, it was found that the fractured portion of bone had produced a transverse wound of the heart about an inch in length. The cavities of the organ had not been penetrated, but the piece of bone was exactly adapted to the depression produced by it on the parietes. (Devergie, Méd. Lég. vol. ii. p. 243.) A witness will frequently be required to take into consideration the effects of contusions on the thorax, with or without fracture, in cases of death from pugilistic combats which of late years have given rise to so many trials of manslaughter. Wounds penetrating into the cavity of the thorax, are generally dangerous even when slight, in consequence of the numerous accidents with which they are liable to be complicated. In these wounds, the lungs are most commonly injured; but, according to the direction of the weapon, the heart, or the great vessels connected with it, as well as the œsophagus or thoracic duct, may share in the mischief.

THE LUNGS.—The immediate cause of danger from wounds of these organs is the consequent hæmorrhage, which is profuse in proportion to the depth of the wound and the size of the vessels wounded. Should the weapon divide any of the trunks of the pulmonary veins, the individual may speedily sink. The degree of hæmorrhage cannot be judged of by the quantity of blood which escapes from the wound; for it may go on internally, and collect within the cavity of the pleura,

impeding the respiratory process. This is especially to be apprehended when the external orifice is small and oblique, and one of the intercostal arteries has been touched by the weapon. A wound of the lung is generally known, among other symptoms, by the frothiness and florid colour of the blood which issues from the orifice, as well as by the expectoration of blood. The lungs may sustain serious injury from a blow or fall, and yet there may be no external marks of violence or symptoms indicative of danger for some hours. A young man, while riding, fell from his horse on his left arm. He complained of no pain for five hours, but in twelve hours, he was seized with an alarming flow of blood from the mouth. He died in the course of a few days. After death there was no mark of injury to the chest, but the right lung was ruptured posteriorly throughout its length, and much blood had become extravasated. (Lancet, Nov. 1842.) During the convalescence of an individual who has survived the first effects of a penetrating wound of the chest, the surgeon should observe whether death, when it occurs, may not have been caused by any imprudence on the part of a patient, as by abuse of regimen or other misconduct; for, it has been already remarked, circumstances of this nature, would be regarded as mitigatory on the trial of an aggressor. Thus it is very properly recommended that, in all cases where a party is progressing to recovery, a relaxation of the antiphlogistic regimen should be made with great circumspection. Too much nourishment, too frequent talking or any exertion, are circumstances that may cause a renewal of the hæmorrhage and extravasation. A case is related in which a soldier died instantly from internal hæmorrhage, brought on by throwing a bowl at some nine-pins, two months after he had been apparently cured of a wound of the lungs.

The heart.—These are among the most fatal of penetrating wounds of the thorax. It was formerly considered that all wounds of this organ were necessarily and instantly mortal. Undoubtedly, when either of the cavities is laid open to a large extent, the hæmorrhage is so profuse on the withdrawal of the weapon, that death must be immediate. But when the wound is small and penetrates into the cavities of the organ obliquely, life may be prolonged for a considerable period; and cases are on record in which it is probable that such wounds would have healed, and the patients have finally recovered, but for the supervention of other diseases which destroyed life.

For cases in illustration of the position that wounds of the heart are not instantaneously mortal, see Med. Gaz. ii. 721, also vol. xiii. p. 662. In the opinion of Baron Dupuytren these injuries are not necessarily fatal, although I believe, with one exception, there is no case on record in which a person has recovered from a penetrating wound of the cavities. (Ed. M. and S. J., Oct. 1844, 557.) There are few, probably, who will be inclined to consider them curable; a remote possibility of simple wounds healing, and of the patient re-

covering, may be admitted; but until some clear instances of recovery from penetrating wounds of the cavities are reported, the majority of practitioners will continue to look upon them as necessarily, although perhaps not immediately, fatal. From a series of cases collected by MM. Ollivier and Sanson, it appears, that out of twenty-nine instances of penetrating wounds of the cavities of the heart, only two proved fatal within forty-eight hours. In the others, death took place at the varying periods of from four to twenty-eight days after the receipt of the wound. (Devergie, Méd. Lég. vol. ii. p. 246.) These differences in the time at which death occurs, as well as the reason why wounds of the heart do not instantly destroy life, have been ascribed to the peculiar disposition of the muscular fibres of the organ, and to the manner in which they are penetrated by a weapon. Thus, as a general principle, it is stated that wounds which are parallel to the axis of the heart, are, cæteris paribus, less rapidly fatal, than those which are transverse to its axis. In a wound which divides the fibres transversely, the opening will be larger, and the hæmorrhage greater, than in one which is parallel to these fibres; and as the heart is composed of different layers, of which the fibres pass in different directions, so in a penetrating wound of its cavities, while one set tends to separate the edges, another tends to bring them together and to restrain the flow of blood. It is this action of the fibres, which renders wounds of the ventricles less rapidly fatal than those of the auricles, all other circumstances being equal; but a man has been known to survive a laceration of the left auricle for eleven hours. (See Lancet, Jan. 1841.) The presence of a weapon in the wound, also retards the fatal result, by mechanically obstructing the effusion of blood. It appears from a series of observations by M. Ollivier and others, that the right cavities of the heart are more frequently wounded than the left, and of these the right ventricle is most commonly the seat of injury. Out of sixty-four cases of wounds of this organ, twenty-nine were situated in the right ventricle, twelve in the left ventricle, nine in the two ventricles, three in the right auricle, and one in the left auricle. These differences are readily accounted for by the relative situation of the cavities. It appears also, from M. Ollivier's observations, that wounds of the right ventricle are not only the most frequent, but of all others, they are the most rapidly mortal. It is considered that the suddenness of death in severe wounds of the cavities of this organ, is to be ascribed not merely to the loss of blood, but to the degree of compression which it experiences from that which is poured out into the bag of the pericardium.

The heart is liable to be *ruptured* either from disease or accident. The organ generally gives way towards the basis, and through one of the cavities on the right side. (For cases see Med. Chir. Rev. xxxi. 532.) The symptoms are sudden pain and collapse, and death speedily ensues:—according to the circumstances under which they occur, these cases of rupture from disease may always excite a suspicion of death from violence. Sometimes the substance of the heart ap-

pears to undergo a fatty degeneration; but at others there is no apparent cause for the accident. Dr. Stroud reported to the Med. Chir. Society, a case of this kind, which occurred in a young man aged twenty-nine. The deceased died in ten hours after his first seizure: on inspection there was a small aperture in the right auricle near the vena cava. This did not appear to be connected with any morbid condition of the heart. (Med. Gaz. xxvi. 518, Lancet, Nov. 1843.) As a medico-legal subject, it is worthy of note that when this alarming accident proceeds from blows or falls, it is not always accompanied by any marks of external violence,—or any fracture or other injury to the parietes of the thorax. A case is recorded by Dr. Gairdner, in which a cart-wheel passed over the chest of a child, and occasioned instant death. Dr. Christison met with two similar instances, one caused by a fall, and the other by a blow. I have been enabled to collect two others, one of which was communicated to me by Dr. Geoghegan of Dublin. A child was killed, as it was supposed, by the wheel of a carriage going over its chest. On inspection the integuments, muscles, and ribs, were entirely free from any marks of injury. The pericardium was lacerated, and a pint of blood was effused into the right pleural cavity. The heart was found ruptured throughout its entire length. In another case, which occurred to Mr. Jeffery, of Sidmouth, a man fell from a cliff the height of one hundred feet. There were a few slight bruises about the body, but no serious wound or fracture. On opening the chest, the pericardium was found to be distended with dark fluid blood, which had escaped from an irregular opening about three quarters of an inch in diameter, situated in the anterior portion of the right auricle. (For another case, see Cyc. Pr. Med. iv. 557.)

Wounds of the *large arterial and venous trunks,* around the heart, must be considered as decidedly mortal: death is generally instantaneous from the profuse hæmorrhage which attends them. Dr. Heil, of Bamberg, has related a case which he considers to prove that a person may recover from a penetrating wound of the ascending aorta. (Henke Zeitschrift, 1837, ii. 459.) With regard to these fatal extravasations of blood within the chest as well as in the other great cavities, it may be proper to mention that, from whatever vessel or vessels the blood may have issued, it is not commonly found coagulated to any extent. The greater part of it generally preserves the liquid state: and it is rare that so much as one half of the quantity effused, is met with in the form of coagulum. These extravasations of blood in the chest may be sometimes traced to wounds of the intercostal, the internal mammary arteries, or of the vena azygos.

The Diaphragm.—This muscular septum is liable to be wounded by weapons which penetrate the cavity of the thorax or abdomen; but, under any circumstances, such wounds are not likely to occur without implicating the important organs that are in contact with it. It is scarcely possible, therefore, to estimate the danger of these inju-

ries, as the prognosis must materially depend on the concomitant mischief to the viscera. Slight penetrating wounds of the muscle may heal, like those of other muscular parts; and cases of this kind are on record. There is, however, always a consecutive source of mischief which no remedial means can avert;—namely, that after the wound has, to all appearance, healed, the life of a party may be cut short by the strangulation of a portion of the stomach or viscera in the half cicatrized aperture. An instance reported by Dr. Smith affords an illustration of this. A sharp-pointed weapon had penetrated the diaphragm, notwithstanding which the patient made a rapid and perfect recovery, to all appearance. At the end of about three months the man died from a strangulated hernia of the stomach, which had passed through the wound of the diaphragm into the thorax. (For. Med. p. 279.) In a case of this description, when death occurs at a very considerable period after the infliction of a wound, the witness will probably be asked:—Whether the wound was the cause of death? Or whether there were any circumstances which would have caused or facilitated the production of a hernia? The degree of culpability of an aggressor, would materially depend upon the answers returned to these questions. Phrenic hernia, as it is termed, is not by any means an unusual or unexpected fatal consequence of a wound of the diaphragm; and therefore it would appear, at first sight, that death, at whatever period this event might occur, should be referred to the original wound. But the question is of a very delicate nature; as it is possible that a slight blow on the stomach, received subsequently to the wound, or even any moderate exertion on the part of the deceased, might have tended to the production of the strangulation, or at least might have added to its fatal effects. The most serious wounds of the diaphragm, are unquestionably those which are produced by violent contusions, or falls on the parietes of the abdomen, while the stomach and viscera are distended. In these cases the muscular fibres are commonly found ruptured to a greater or less extent: the hæmorrhage is not very considerable, rarely exceeding two, three, or four ounces. A uniform effect of these *ruptures* when extensive, is a protrusion of the stomach into the chest, with sometimes a rupture of the coats of that organ and extravasation of its contents. The severe lacerations of the diaphragm are more readily produced during the act of inspiration, than during expiration,—the fibres of the muscle being then stretched and receiving, while in this state of tension, the whole of the force. According to Devergie, the rupture most frequently takes place in the central tendinous structure, where it is united with the left muscular portion above the crura. He has remarked that it is observed more commonly on the left side than on the right. (Vol. ii. p. 250.) It has been supposed that death was an immediate consequence of this accident, but this view is not supported by facts. I have elsewhere related a case of extensive rupture of the diaphragm where the stomach and the colon were found in the chest, and yet the person lived nine months after the only accident which

could have produced it, and then died from another cause. (G. H. Rep. Oct. 1838.) Besides the stomach, it sometimes happens that the liver, spleen, or intestines pass through the opening, and like it, these organs are liable to become strangulated: the lungs are, at the same time, so compressed that inspiration is stopped and asphyxia is often an immediate result.

In judging of the *direction* which wounds traversing the antero-posterior axis of the chest, take, it is necessary to remember the great difference which exists in the level of the same rib anteriorly and posteriorly. This must be especially attended to, when we are called upon to state the direction of a traversing wound from the description of it, given by another. The point here referred to had an important bearing in the case of a fatal gun-shot wound which was the subject of a criminal charge some years since. (Henke's Zeitschrift, 1836.)

A person died from a single pellet of small shot traversing the chest from before backwards. The pellet entered between the first and second ribs anteriorly, and traversing the lung, caused death by lacerating the sixth intercostal artery, near its origin at the lower edge of the sixth rib, posteriorly. In giving an opinion on the direction of the wound, a fact which was important in regard to the position of the assailant,—one medical witness, from not duly considering the sloping of the ribs from behind forwards, described the wound behind as being six inches below the level of that in front. As the small canal through the lungs could not be discovered, he was inclined to think that the two wounds could not be connected, because the gun had been discharged from the shoulder when the party firing was nearly on a level with the deceased. This opinion, however, was soon corrected by reference to the anatomical relations of the parietes of the thorax. Indeed it will be found, that a straight line carried backwards from between the first and second ribs in front, will, in a well-formed skeleton, touch the upper border of the fifth rib posteriorly: therefore this wound was nearly horizontal,—being only one inch and a quarter lower posteriorly, than anteriorly. In a late fatal duel, the bullet struck the deceased on the right side, fracturing the seventh rib, and after traversing the posterior part of the lungs, lodged in the ninth dorsal vertebra. These parts are in a line with each other, and the wound was horizontal. It must not be forgotten that a wound immediately below the chest bone, will in its fore part involve the viscera of the abdomen,--in the back part those of the chest, and in its central part it will traverse the diaphragm.

The Abdomen.—*Incised* and *punctured* wounds which affect the parietes of the abdomen, without penetrating the cavity, are not quite of so simple a nature as might at first sight be imagined. The danger is immediate, if the epigastric artery be wounded; for a fatal hæmorrhage, will, in some instances, take place from a wound of this vessel. Among the other sources of danger from these superficial wounds, is inflammation, followed by suppuration beneath the tendinous aponeurosis which covers the abdominal muscles. The matter formed is very liable to accumulate within the tendinous sheath of the rectus muscle, and go on to destroy life, unless proper treatment be adopted. The inflammation will sometimes extend to the peritoneum, and thus prove rapidly mortal. As improper medical treatment may, in either of these ways, cause a superficial wound of the abdomen to

take a fatal termination,—so when an individual stands charged with having inflicted a wound, it will be necessary for the medical witnesses to consider how far the consequences of the act of the prisoner have been aggravated by negligence or unskilfulness. But when these wounds take a favourable course and heal, there is an after-effect to be dreaded, namely, a protrusion of the viscera at the cicatrized spot, constituting ventral hernia. When the wound has involved the muscular fibres transversely to their course, the cicatrix which follows, is commonly far less capable of resisting the pressure of the viscera within, than other parts of the parietes. A hernia will take place, and this, like other herniæ, if neglected, is liable to become strangulated and lead to the destruction of life. *Contusions* are attended generally with far more serious effects on the cavity of the abdomen, than on the thorax. This arises from the abdominal parietes having less power to resist external shocks. In the first place, death may be an immediate result of a blow in the upper and central portion; no particular morbid changes will be apparent on inspection, and the violence may have been so slight, as not to have left any ecchymosed mark on the skin. Death has been ascribed in these cases to a fatal shock transmitted to the system, through a violent impression produced on the solar plexus. In a case of manslaughter tried at the Cent. Crim. Court, in Aug. 1841, death had been caused in this way during a pugilistic combat. The man received a blow in the stomach and fell dead. As there were no marks of external injury, the surgeon thought the man had died of apoplexy. The prisoner was acquitted. (*The Queen against Sayers.*)

Blows on the abdomen, when they do not destroy life by shock, may cause death by inducing peritoneal inflammation. Several cases of this kind are mentioned by Mr. Watson, (On Homicide, 186,) and more than one has been tried of late years where violence to the abdomen was proved, but no mechanical lesion had been produced: the wounded person, however, died from peritonitis in the course of a few days. (The *Queen against Martin*, Cent. Crim. Court, 1839.) Peritonitis thus induced, is apt to be accompanied by inflammation of serous membranes in other cavities:—thus, it is said, a person may be cut off by pleuritis depending an an attack of peritonitis, produced by violence, while the former disease would probably be referred to some other cause. In a case which occurred a few years since,— a woman received some severe blows on the abdomen from her husband. She died in five days afterwards. There were marks of pleuritis and peritonitis on dissection, the former much more decided. The medical witness, while he allowed that the peritonitis might have been caused by blows, thought that death had been produced by an attack of pleuritis from cold. The jury acquitted the husband.—The reporter of the case considers that the attack of pleurisy was immediately dependent on the peritoneal inflammation produced by the violence. (See Med. Gaz. xxv. 13.) This doctrine requires confirmation before it can be safely applied to medico-legal practice. Such a sympathetic con-

nexion between the two diseases must not only be rendered probable, but actually proved.

Blows upon the abdomen may also prove fatal by causing a rupture of the viscera with extravasation of blood;—and as it has been elsewhere stated, these serious injuries may occur without being attended by any marks of external violence. Of all the internal organs, the liver and spleen are the most exposed to rupture, owing to their very compact structure, which prevents them from yielding to a shock, like the hollow viscera. Ruptures of the *liver* occur from falls or blows; but this organ may be ruptured merely by a sudden action of the abdominal muscles. This accident happened to an individual who was endeavouring to avoid a fall from his horse. (Male's Jur. Med. 119.) They are generally seen on the convex surface, seldom extending through the whole substance of the organ, but consisting of fissures, varying from one to two inches in depth. Their usual direction is from before backwards, with a slight obliquity; they rarely intersect the liver transversely. The lacerated edges are not much separated, while the surfaces present a granular appearance. But little blood is met with in the laceration; it is commonly found extravasated in the lower part of the cavity of the peritoneum, or in the hollow of the pelvis, and is only in part coagulated. Ruptures of the liver, unless they run far backwards and involve the vena cava, are not in general attended with any considerable extravasation of blood; but the hæmorrhage, should this vessel be implicated, is sufficient to cause the instant destruction of life. Under other circumstances, a person may survive some hours.

Ruptures of the *spleen* may occur either from violence or disease, and it would appear from the following case, reported by Mr. Heddle, (Med. Chir. Rev. Oct. 1839,) that a very slight degree of violence is sufficient to rupture this organ, while there will be no marks of injury externally. A middle-aged man was observed fighting with a boy about fourteen years of age, who in stature scarcely reached to his waist. When the fight terminated, the boy ran away; the deceased was observed to become very weak and faint, and he complained of uneasiness in his left side. He expired a few minutes afterwards. On inspection, there was no mark of violence externally. The cavity of the abdomen contained a large quantity of blood. The spleen was found enlarged, and so softened, that its structure was broken down by the slightest pressure. There was a laceration across its surface, about half an inch in depth, from which the fatal hæmorrhage had proceeded. A case of spontaneous rupture of the spleen, when in an enlarged and diseased condition, will be found in the Medical Gazette, (June, 1842.) It is highly probable, that when the liver and spleen are ruptured from slight causes, these organs will be found diseased,—a circumstance which may in some cases be regarded as mitigatory of the act of the assailant. (See also Med. Gaz. xxxv. 942.)

Wounds or ruptures of the *gall-bladder* are fatal, owing to the extravasation of the bile which uniformly induces peritonitis. The *kid-*

neys are occasionally ruptured from violence, but this appears to be a rare accident. Two cases were reported by Mr. Stanley to the Med. Chir. Soc. (Lancet, Nov. 1843.) In one, the individual recovered—in the other, death did not take place for a considerable time.

Ruptures of the *intestines* sometimes takes place from disease, and in a case of rupture alleged to have been produced by violence, we must always take this possible objection into account. The ruptured part should be carefully examined, in order to see whether there be any signs of ulceration about it. If not, and there is clear evidence of violence having been used, it is impossible to admit this speculative objection. If with the proof of violence there should also be a diseased condition of the bowel, we may be required to say whether in consequence, there was not a greater liability to rupture,—a point which must be admitted. For interesting medico-legal cases see Watson on Homicide, 159; also, Henke Zeitschrift der S. A. 1836, Erg. xxii. and Brit. and For. Rev. iv. 519. Rupture of the intestines will occur from the slightest causes. Any force suddenly applied, as a smart shock to the abdomen, will sometimes suffice to cause it. A case has already been related where the blow of a pebble ruptured the jejunum of a young girl by striking the abdomen. For an interesting case by Mr. Newton, in which there was no doubt that the ileum had been ruptured by a blow on the abdomen, leading to death by peritonitis, see Lancet, Aug. 9, 1845, 146. It is worthy of remark, that a rupture of the intestines does not necessarily deprive a person of the power of locomotion. Mr. Collier has reported the case of a boy aged thirteen, whose duodenum was completely ruptured across by a blow, who walked a mile with but little assistance; he died in thirteen hours. (See Med. Gaz. xii. 766.) That rupture of the intestines is not incompatible with the power of locomotion, is also proved by a case related by Mr. Ellis, of Dublin, where the cœcum was ruptured; the man was able to walk after the accident, but he died in twenty-four hours. Other instances of this kind are reported by Henke. The ileum is observed to be most liable to rupture from accident. Punctured wounds which merely touch the bowels without laying open the cavity, are liable to cause death by peritonitis. These injuries to the intestines sometimes destroy life by shock; there is but little blood effused, and the wounded person dies before peritonitis can be set up.

Ruptures of the *stomach* may cause death by shock; they give rise to the most excruciating pain, which of itself is sufficient to bring about rapid dissolution. It is proper to state, however, that the stomach may become ruptured from spontaneous causes, as in ulceration produced by disease, (ante, p. 58,) but sometimes there is no morbid cause to explain the result. In April, 1828, a man aged thirty-four, was brought into St. Bartholomew's Hospital, complaining of severe pain in the abdomen. Ten hours afterwards, he was seized with violent vomiting, the pain ceased, the vomiting also ceased; and he died in five hours more. The posterior surface of the stomach was found lacerated to the extent of three inches, and the contents of the organ had escaped through the aperture;

the mucous membrane was reddened, but there was no thickening, ulceration or any apparent disease of the stomach. (Med. Gaz. ii. 182. See also Dub. Med. Jour. May, 1845, and Ed. Med. and Sur. Jour. Oct. 1845, p. 522.) It is obvious, that in alleged ruptures from violence, accidents of this kind must not be forgotten. Penetrating wounds of the stomach generally prove rapidly mortal; they seldom form a subject of medico-legal examination; but a singular case was tried at the Norwich Assizes in 1832, where a man was charged with the murder of his wife, by throwing at her a red-hot poker. The weapon completely perforated her stomach, and she died in six hours. It might be questioned whether this was a wound in the common sense of the term; it was an injury compounded of a burn, puncture, and laceration.

Rupture of the *bladder*. This injury is frequently the result of blows on the lower part of the abdomen, and it has on several occasions of late years given rise to some medico-legal discussion. The principal questions to be answered are: Was the rupture the result of wilful violence or of an accidental fall? or did it proceed from spontaneous causes, as from over-distension? The spot where rupture commonly takes place is in the upper and posterior part, where the organ is covered by the peritoneum. The aperture is sometimes large, at others small; but the effect is, that the urine is extravasated and death takes place through peritoneal inflammation. These ruptures have, I believe, without exception, proved fatal from this cause. One probable exception was however reported by Mr. Arnott to the Med. Chir. Soc. (Lancet, Nov. 1843.) The time at which death occurs is from three to seven days, but Mr. Ellis met with a case where the person did not die until the fifteenth day. There is another circumstance of medico-legal importance in respect to these ruptures, namely, that when produced by a blow, they are rarely accompanied by the slightest mark of echymosis, or of injury to the skin. Thus, then there are no means of distinguishing by an examination, whether the rupture was really due to violence or spontaneous causes. Those who are unacquainted with this fact, might be disposed to refer the rupture to disease, on the supposition that violence would be indicated by the usual characters externally; but the following cases will show that this view is erroneous. During a quarrel one man struck another a severe blow on the lower part of the abdomen. The latter was carried home, confined to his bed, and died in seven days. On inspection, there were only a few superficial excoriations on the skin of the abdomen. The bladder was found ruptured to the extent of two inches in its upper and back part; it was highly inflamed. Throughout the abdomen there were the marks of general peritoneal inflammation, of which the man had died. There was a sanguineous fluid effused, exhaling a strong ammoniacal odour. The person who inflicted the blow was convicted of culpable homicide. (Ann. d'Hyg. 1836, 207.) Some doubt seems to have been thrown on the correctness of the medical opinion, that the rupture had been caused by a blow, because there was no ecchymosis or other

marks indicative of a severe blow over the region of the bladder. The witnesses properly answered, that ruptures of the viscera of the abdomen from violence, were not necessarily attended with the marks found in injuries to other parts, owing to the yielding and elastic nature of the parietes. One mentioned a case that had recently occurred to him, where a soldier had received in the abdomen, a kick from a horse, which had ruptured the small intestines, and caused death; but there was not the slightest trace of violence externally.

The next case is that of the *King against Eccles*, tried at the Lancaster Lent Assizes, 1836. The prisoner, who was half intoxicated, met the deceased in the high road, and without receiving any provocation, gave him a violent kick on the lower part of his abdomen. The deceased turned sick; he attempted to pass his urine, but could not; he was conveyed home, and died from peritonitis in five days. On inspection, there was no ecchymosis, or other injury to the skin indicative of external violence, but the bladder was found ruptured, and the contents extravasated. The rupture was attributed to the blow inflicted by the prisoner. In the defence, it was urged with great plausibility, that as there was no mark of a blow, the rupture might have occurred spontaneously from simple over-distention. The judge in summing up, observed that if the rupture were thus occasioned, it was extraordinary that it should have happened immediately after a violent blow had been struck on the part. The distention of the organ might, however, have rendered the blow more dangerous than it otherwise would have been. The prisoner was convicted. As an attempt may always be made on these occasions to refer a rupture of this organ to natural causes, it may be observed that this is a very unusual occurrence; a rupture is almost always the result of violence directly applied to the part while the organ is in a distended state. A spontaneous rupture may, however, occur. 1. When there is paralysis, and a want of power to expel the urine; 2, when the bladder is ulcerated or otherwise diseased; 3, when there is an obstruction in the urethra from stricture or other causes. These causes of spontaneous rupture are easily recognizable by ascertaining the previous condition of the deceased, or examining the bladder and urethra after death. If a man were in good health prior to being struck,—if he suddenly felt intense pain, could not pass his urine afterwards, and died from an attack of peritonitis in five or six days; if after death, the bladder was found lacerated but this organ and the urethra were otherwise in a healthy condition, there can be no doubt that the blow was the cause of rupture and death. In such a case, to attribute the rupture to spontaneous causes, would be equal to denying all kind of causation. As to the absence of marks of violence externally, this would only be a difficulty to those who had not previously made themselves acquainted with the facts attending this accident. Nevertheless, the medical witness must be prepared to hear the same line of defence continually urged; it is the object of a counsel to make the best of a case for the prisoner, and his duty consists in seeing him judged according to law, and not condemned

contrary to law; with medical facts, opinions, and doctrines he does not concern himself, so long as they do not serve his purpose.

A diseased state of the bladder might probably diminish the responsibility of an accused person for the consequences; therefore, the state of this organ should be closely looked to on these occasions. From the summing up of the judge in the last case, it might be inferred, that the fact of the bladder being distended at the time of the blow, would be held a mitigatory circumstance; but we can hardly suppose that such would be the opinion of our judges. The fact is, this most serious injury is never liable to occur from violence, except when the bladder is actually distended, which is occasionally its natural condition! If there were anything unnatural or abnormal in the bladder containing urine, such a rule might, perhaps, apply; but as it is not so, the rule would hold out to persons a ready means of certainly destroying life without subjecting them to the same degree of responsibility as if they caused death in other ways. Can the bladder be ruptured by an accidental fall, and if so, by what kind of fall? The following case reported by Mr. Syme, of Edinburgh, will show that this accident may readily occur. A woman, aged twenty-six, fell forwards over the edge of a tub, and fainted immediately. On recovering herself, she complained of intense pain in the abdomen, with inability to pass the urine. Peritonitis came on, and she died in a week. On inspection, a small aperture was found in the fundus of the bladder; the peritoneum was extensively inflamed from the urine which had become effused. The ruptured surfaces had become partly glued together. (Ed. Med. and Sur. Jour. Oct. 1836.) Rupture of the bladder may take place from an accidental fall, and cause death without necessarily laying open the peritoneal cavity. Two interesting cases of this kind, have been reported by Mr. Wells. (Med. Gaz. xxxvi. p. 621.) The patients were sailors, who fell from their hammocks while in a state of intoxication. The usual symptoms followed, one died in five and the other in eight days from peritonitis; and after death it was clearly found, in one instance at least, that the bladder had been ruptured in the usual situation, but the peritoneum was entire although in a state of intense inflammation.

This accident is liable to occur in females during parturition, owing to the pressure of the child's head, an occurrence which may fix a charge of malapraxis on the medical attendant. He is expected to know the probability of such an accident occurring, and to guard against it, if necessary, by the frequent use of the catheter. A surgeon was a few years since tried on a charge of this kind. *Reg.* v. *Balsoner*, Liverpool Lent Assizes, 1838. It is important to remember, that although rupture of the bladder is commonly attended with intense pain, sickness, and prostration of strength, yet individuals may occasionally retain the power of exerting and moving themselves after the accident. (See cases, ante, p. 371.) In punctured and incised wounds of the bladder, the urine is immediately extravasated, but in gun-shot wounds, the extravasation does not commonly take place until the

sloughs have separated. Thus, life may be protracted longer in cases of gun-shot, than under other wounds of the bladder. Barzellotti relates the case of a medical student, shot through the bladder in a duel, who did not die until the *twentieth day*, from the peritonitis which supervened on the extravasation. (Questioni di Med. Leg. t. iii. 174.) And one instance of a person recovering from a gun-shot wound perforating the bladder, is reported by Mr. Douglas in the Ed. Med. and Sur. Jour. Vol. xiii. For the discovery of extravasated liquids or blood in wounds, and other injuries to the abdominal viscera, we must look to the cavity of the pelvis, as it is here that for obvious reasons, such liquids have a tendency to collect.

THE GENITALS.—Wounds of these organs do not often require the attention of a medical jurist; such wounds, whether in the male or female, may, however, prove fatal to life by excessive hæmorrhage. Self-castration or mutilation is not unfrequent among male lunatics and idiots. An inquest was held some time since in London, upon an idiot, who had bled to death from a wound of this description. When timely assistance is rendered, a fatal result may be averted. Incised wounds to the female genitals may prove fatal by hæmorrhage, not from the wound involving any large vessel, but from the great vascularity of the parts. Two females were in this way murdered in Edinburgh, some years since. The wounds were inflicted by razors, and the women bled to death. (See cases by Watson, p. 104.) This crime appears to have been at one time frequent in Scotland. When deeply incised wounds are inflicted upon the genital organs of either sex, the fact of their existence in such a situation, at once proves wilful and deliberate malice on the part of the assailant. Accident is wholly out of the question, and suicide is improbable, except in cases of confirmed idiocy and lunacy. Such wounds require to be carefully examined; for the proof of the kind of wound, when fatal, may be tantamount to the proof of murder.

CHAPTER XXXV.

FRACTURES AND DISLOCATIONS.

THESE injuries have some important bearings in relation to medical jurisprudence. FRACTURES may result from falls, blows, or the spontaneous action of muscles. (See on this subject an elaborate statistical paper by M. Malgaigne, Ann. D'Hyg., 1839. ii. 241; also on fractures in infants, by M. Ollivier, Ann. D'Hyg. 1844. ii. 146.) Questions

are sometimes put as to whether a particular fracture was caused by an accidental fall or a blow; and if by a blow, whether by the use of a weapon or not. It is obvious that the answers must be regulated by the circumstances of each case. In examining a fracture, it is important to determine, if possible, whether a *weapon* has been used or not, and this may be sometimes known by the state of the parts. It is a common defence on these occasions, to attribute the fracture to an accidental fall. Fractures more readily occur from equal degrees of force in the old, than in the young; and in the young rather than in the adult; because, it is at this period of life that the bones possess their maximum degree of firmness and solidity. The bones of aged persons are sometimes very brittle, and slight violence will then produce fracture. This is sometimes looked upon by our judges as an extenuating circumstance, when the fracture is followed by death. Certain diseases also render bones more fragile; this has been observed in syphilis, arthritis, cancer, scurvy, and rachitis. In such cases, a defence might fairly rest upon an abnormal condition of the bones, provided the violence producing the fracture, was slight. Two trials have lately taken place where this fragility of the bones became a subject of discussion. But the fracture may be attributed to *spontaneous* causes, even supposing there are no well-marked signs of disease. Thus, bones have been fractured by violent muscular exertion. The olecranon, os calcis and patella are particularly exposed to this accident. The long bones are very seldom the subject of an accident of this kind; but the os humeri has been thus broken. Mr. May reports the case of a young lady, who fractured the neck of the scapula by suddenly throwing a necklace on her neck. (Med. Gaz. Oct. 1842.) It is probable that in all these instances, if the bone were closely examined, it would be found to have undergone some chemical change in its composition, whereby it was rendered brittle. In cases of this kind, there would be no abrasion of the skin, or any appearance to indicate that a blow had been struck, while the marks of a blow would, of course, remove all idea of the fracture having had a spontaneous origin. Fractures are not *dangerous to life,* unless when of a compound nature, they occur in old persons, or in those debilitated by disease or dissipated habits. They may then cause death by inducing irritative fever, erysipelas, gangrene, tetanus, or delirium tremens.

It is not always easy to say, whether a fracture has been produced *before or after death.* A fracture produced shortly after death, while the body is warm, and another produced shortly before death, will present much the same characters, except, perhaps, that in the former case there would be less blood effused. One caused ten or twelve hours before death, would be indicated by copious effusion of blood in the surrounding parts, and between the fractured edges of the bones; or if for a longer period before death, there may be the marks of inflammation. Fractures caused several hours after death, are not accompanied by an effusion of blood. A medical witness may be asked, how long did the deceased survive after receiving the fracture? This

is a question which can only be decided by an examination of the fractured part. Unless the individual has survived eighteen or twenty-four hours, there are commonly no appreciable changes. After this time, lymph is poured out from the surrounding structures. This slowly becomes hard from the deposition of phosphate of lime, and forms what is called "callus." In the process of time, this acquires all the hardness of the original bone. The death of a person may take place during these changes, and a medical man may be required to state the period at which the fracture probably happened, in order to connect the violence with the act of a particular person. Unfortunately, we have no satisfactory data, if we except the extreme stages of this process, upon which to ground an opinion. We can say whether a person lived for a long or a short time after receiving a fracture, but to specify the exact time is clearly impossible; since this process of restoration in bone varies according to age, constitution, and many other circumstances. In young subjects, bones will unite rapidly, in the old slowly; in the diseased and unhealthy, the process is very slow, and sometimes does not take place at all. According to Villermé, the callus assumes a cartilaginous structure in from sixteen to twenty-five days; and it becomes ossified in a period, varying from three weeks to three months. It requires, however, a period of from six to eight months for the callus to acquire all the hardness, firmness, and power of resisting shocks, possessed by the original bone. A force applied to a recently united bone, will break it through the callus, or bond of union, while after the period stated, the bone will break as readily through any other part. It is generally set down, that the period required for the union of a simple fracture, is, in the thigh-bone, six weeks; in the tibia, five weeks; in the os humeri, four weeks; and in the ulna and radius, three weeks; in the ribs, about the same period; but cases have been known where the ribs had not perfectly united in two months, and in some of the other bones, union had not taken place in four months.

Has a bone ever been fractured? This question is sometimes put in reference to the living subject. It is well-known that a bone seldom unites so evenly, but that the point of ossific union is indicated by a node or projection. Some bones are well placed for this examination, as the radius, the clavicle and tibia,—these being but little covered by skin; in others, the detection is difficult. It is impossible for us to say when the fracture took place; it may have been for six months or six years, since, after the former period, the bone undergoes no perceptible change. These facts are of importance in relation to the dead; since they will enable us to answer questions respecting the identity of skeletons found under suspicious circumstances; and here medical evidence may take a wider range, for a fracture in any bone, may be discovered, if not by external examination, at least by sawing the bone through the suspected broken part, when, should the suspicion be correct, the bony shell will be found thicker and less regular in the situation of the united fracture, than in the normal state. So, in such cases,

it will be easy to say whether a fracture is recent or of old standing. In the case of *Clarke*, who was murdered many years since by Eugene Aram, the traces of the fracture and indentation of the temporal bone, were plainly distinguished on the exhumation of the skeleton of the deceased, thirteen years after the perpetration of the murder. The manner in which the murder was committed, was confessed by an accomplice, and the medical evidence corroborated this confession. An instance of the utility of this kind of knowledge came out on the trial of a gentleman in India, for the murder of a native, *Meer Khan*, in 1833. There was some reason to suppose, that the prisoner had been falsely accused of causing the death of the native. Two witnesses deposed that a few hours before the deceased died, the prisoner had struck him several blows on the chest, and had broken his ribs. The alleged murder having taken place some months previously to the trial, a skeleton was produced as being that of the deceased, by one of the persons who had assisted in burying him. On examining the ribs, the medical witness found that only one rib was broken, and the fractured portions were united by a firm osseous callus. He, therefore, declared, that the fracture could not have been caused a few hours before death; but that it must have existed for a period of at least eight or twelve days. Hence, the account given by the witnesses, was rendered improbable; for the prisoner had used no violence to the deceased, except just before his death; the fracture, therefore, must have taken place from another cause some time previously. The witness much understated the period at which the fracture probably occurred; for ossification only commences in the cartilage about the sixth day; and the specks of bony matter continue to increase from the eighth to the twelfth day, but the union is soft, and it is some weeks before the callus becomes perfectly firm and hard.

With respect to the power of *locomotion* after a fracture, it may be observed, that when the injury is in the upper extremity or in the ribs, unless many of them be broken, an individual may move about although unfitted for great exertion. Fractures of the lower extremity, incapacitate a person from moving except to very short distances. See case by Syme, Ed. Med. and Surg. Jour. Oct. 1836.

Dislocations.—These accidents are not very frequent in the old or in those persons whose bones are brittle. They rarely form a subject for medico-legal investigation. A witness is liable to be asked, what degree of force, and acting in which direction, would produce a dislocation,—a question not difficult to answer. They are not dangerous to life, unless of a compound nature, when death may take place from secondary causes. A dislocation in the living body would be known after death by the copious effusion and coagulation of blood. For a good account of the post-mortem appearances four days after a dislocation of the humerus, see Med. Gaz. xxxi. 266. If of old standing, a dislocation would be identified by the cicatrices in surrounding structures. Dislocations may occur from natural causes, as from disease

and destruction of the ligaments in a joint, also from violent muscular spasm during an epileptic convulsion. Dr. Dymock met with an instance of dislocation of the humerus forwards during puerperal convulsions.—(Ed. Med. and Surg. Jour. April, 1843, see also Lancet, April, 1845, 440.) Locomotion may exist except when the injury is in the lower extremity, and even then it has been observed, that for some time after a dislocation of the hip joint, considerable power over the limb remains; it is only after a few hours, that it becomes fixed in one position. Exertion with the dislocated member, is, in all cases, out of the question.

There are certain fractures of an obscure kind which closely resemble dislocations. This has been pointed out by Sir A. Cooper, in relation to fractures through the anatomical neck of the os humeri. (Guy's Hosp. Rep. ix. 272.) This accident might be easily mistaken for a dislocation. (Med. Gaz. xxxvi. p. 38.) In attempting to reduce the bone, the head continually falls back into the axilla. In such a case, an action for malapraxis might be brought against a surgeon, and heavy damages recovered. It could only be by a dissection of the part after death, that the real nature of the case would be ascertained. It is requisite, therefore, that great caution should be used in the diagnosis. The same observations apply to fractures of the neck of the thigh-bone, although with less force, because this is a much more common accident. It is well known, that fractures and dislocations, when cured, are often attended either with some slight *deformity* in the limb, or with some impairment of its functions. This result is occasionally inevitable under the best treatment; but it is commonly set down as a sign of unskilfulness in the medical attendant. Actions for malapraxis are instituted, and in spite of good evidence in his favour, the surgeon is sometimes heavily fined for a result which could not be avoided. There is often great injustice in these proceedings, and the mischief can only be remedied by referring the facts to a medical tribunal, which alone should be competent to decide whether or not unskilfulness had really been shown in the management of a case.

CHAPTER XXXVI.

GUN-SHOT WOUNDS.

Gun-shot wounds are of the contused kind, but they differ from other wounds, in the fact that the vitality of the parts struck by the projectile is destroyed, leading ultimately to a process of sloughing. The legal definition of a wound applies here, as in other cases, so that in order to constitute a gun-shot wound within the meaning of the

statute, the cutis must be injured. In the case of the *Queen against Mortlock,* tried at the Cambridge Lent Assizes, 1843, the surgeon deposed that there was a circular wound on the skin, by which it had been deprived of its cuticle, but the true skin was not penetrated. The bullet had struck obliquely at a very considerable angle; had it been otherwise it must have entered the abdomen. The judge said that as the true skin was not penetrated, there was no wounding within the meaning of the statute. The medico-legal questions which arise out of gun-shot wounds, āre much the same as those which have been examined in relation to other wounds. They are very *dangerous to life,* more especially when they penetrate or traverse any of the great cavities of the body. Death may take place directly from hæmorrhage or shock; although immediate or copious hæmorrhage is not a common character of these injuries. Death from shock is occasionally witnessed. In the case of the policeman *Daly,* who was killed by a pistol-bullet in Hornsey Wood, May, 1842, it was found, on inspection, that the bullet had traversed the distended stomach at the cardiac end from behind forwards. The two apertures were about the size of a shilling, and the edges black. There was but little blood effused, and the other viscera were uninjured. The deceased died in a few seconds after receiving the wound, obviously from a shock to the nervous system. (Lancet, May, 1842.) Indirectly, these wounds are attended with much danger:—sloughing generally takes place uniformly throughout the whole of the perforation, and inflammation or fatal hæmorrhage may cut short life. If the individual survive the first effects, he may die at almost any period from suppurative fever, erysipelas, gangrene, or from the results of operations absolutely required for his treatment. Gun-shot wounds may thus destroy life after very long periods of time. Marshal Maison, one of Napoleon's generals, died in Paris in 1840, it is said from the effects of a gun-shot wound received forty years before. In gun-shot wounds of a severe kind, the first symptoms do not always indicate the degree of mischief. This was seen in the case of Mr. Drummond, who was shot by *M'Naughten,* in January, 1843. The symptoms were in the first instance so slight, that the bullet was supposed not to have penetrated the cavity of the abdomen; but to have coursed round the skin. Death took place in a few days, and it was then found that the bullet had completely traversed the abdomen, perforating the diaphragm. Army surgeons have also remarked that slight wounds of the parietes, are often insidiously attended with deep-seated injury. Death might in such a case be improperly ascribed to mismanagement, when it may have been really due to the wound. (See Cases by Mr. Alcock, Med. Gaz. xxiv. 850.) It is not easy to mistake a gun-shot wound for any other injury. If the circumstances under which it is produced, do not satisfactorily account for its origin,—a simple examination will suffice to show its true nature. Sometimes the projectile is found lodged in the wound.

A medical witness may be asked, whether the wound was inflicted *before or after death.* It is by no means easy to answer this

question, unless the bullet has injured some vessel, when the effusion of blood, and formation of coagula, will indicate that the person was living when it was received. In a gun-shot wound on the dead, no blood is effused, unless the bullet happen to strike a vein. A very frequent question is, whether the wound was caused by a bullet *fired near or from a distance.* A gun-shot wound produced by the muzzle of the piece being placed near to the surface of the body, has the following characters. There may be two apertures, the one of entrance and the other of exit; but it sometimes happens that the bullet lodges and does not pass out. The edges of the aperture of entrance appear blackened, as if they had been burnt, arising from the heat and flame of the gunpowder at the moment of explosion. The skin is often ecchymosed, and is much blackened by the powder:—the clothes covering the body are blackened by the discharge, and sometimes ignited by the flame. If the muzzle of the piece was not in immediate contact with the part struck, the wound is rounded; but if there has been direct contact, the skin, besides being burnt, is torn and much lacerated. The hæmorrhage is usually slight, and when this occurs it is more commonly from the orifice of exit, than from that of entrance. It should be observed, that the aperture of entrance is round, only when the bullet strikes point-blank or nearly so. If it should strike obliquely, the orifice will have more or less of an oval or valvular form, and in this way we may sometimes determine the relative position of the assailant with respect to the wounded party. Supposing the bullet to have been fired from a moderate distance, but so near as to have had sufficient momentum to traverse the body, then the appearance of the wounds will be different. The orifice of entrance will be well defined, round or oval, according to the circumstances,—the skin slightly depressed inwards,—the edges presenting a faint bruised appearance, but the surrounding parts are neither blackened or burnt, nor do they present any marks of hæmorrhage. In all cases the orifice of exit is large, irregular, the edges somewhat everted, and the skin lacerated but free from all marks of blackness or burning: it is generally three or four times as large as the entrance aperture. This is denied, but to me it appears upon sufficient evidence, by Dr. Malle, Ann. D'Hyg. 1840, 458. The orifice of entrance is, however, always large and irregular, when the bullet strikes near the extremity of its range. Under common circumstances, the entrance-aperture has generally the appearance of being smaller than the projectile, owing to the elasticity of the living skin. See Ann. D'Hyg. 1839, ii. 319. It is the same with the aperture in the dress, when this is formed of an elastic material:—according to Dupuytren, the hole in the dress is always smaller than that made by the bullet in the integuments. These points should be remembered in fitting projectiles to wounds which they are supposed to have produced.

Useful evidence may be sometimes obtained by a careful examination of the *projectile,* the identity of which should be preserved by the medical witness. In the case of the *King against Howe and*

Wood, Stafford Lent Assizes, 1813, it was proved that the deceased had died from a gun-shot wound in the back. The bullet extracted from the wound, was found to have been discharged from a pistol with a screw-barrel. A weapon of this kind was found on the prisoner, as well as a bullet, which had evidently been cast in the same mould as that taken from the body of the deceased. (Will's Circ. Evidence, 264.) On these occasions, the medical attendant should either keep possession of any of the projectiles, which he may remove from a wound, or deliver them only into the hands of responsible persons. An examination of the *dress* alone will sometimes enable us to give an opinion as to where the bullet has passed in, and thus to form a judgment of the direction in which the shot was fired. If a ball strikes at a moderate distance, the aperture in the dress where it enters, is round, and the margin is regularly defined; but the aperture by which it passes out is irregular and torn. In the case of a friend who was wounded in Paris during the revolution of 1830, the ball traversed the left arm:—it had taken out a circular piece of the coat, shirt, and undershirt, where it had entered; but it produced a large irregular opening where it had passed out. Other opportunities occurred to me of verifying the correctness of this remark. Sometimes portions of the dress are carried into the wound,—or if the ball be nearly spent, the dress is elongated like a pouch into the wound. By putting the edges of the cloth together where the bullet has passed in, it may be seen whether any of the cloth has been carried before it. The holes are generally ragged, but the nearer the wounded person is to the assailant, the more perfect is the hole in the dress,—provided the piece be not discharged in immediate contact. The bruised and dark appearance which a gun-shot wound sometimes presents, even when the piece is discharged at a distance from the body, led to the supposition that this effect was due to a burn; and that the bullet burnt the parts which it touched; but this idea has been long exploded. The projectile never becomes sufficiently heated, to acquire the least power of burning.

The question whether a piece was fired *near to or at a distance* from the wounded party, may become of material importance on a charge of homicide, or of alleged suicide. Two persons may quarrel, one having a loaded weapon in his hand, which he may allege to have been accidentally discharged, and to have killed the deceased. If the allegation be true, we ought to find on the body the marks of a near-wound: if, however, it were such as that it had been produced from a distance, and therefore after the quarrel,—the medical proof of this fact might imply malice, and involve the accused in a charge of murder. The following case occurred in Ireland in 1834:—

A tithe-collector was tried for the murder of a man, by shooting him. It appeared in evidence, that the prisoner, while on duty, was attacked by the deceased and two of his sons, and he drew a pistol to intimidate them. He was dragged off his horse by these parties, and during the scuffle, it is supposed, the pistol accidentally went off, and inflicted a wound on the deceased,

of which he died shortly afterwards. The sons of the deceased swore that the prisoner, when at some distance, took a deliberate aim, and fired the pistol at their father; and a priest came forward to depose, that such was the dying declaration of the deceased. From some subsequent suspicion of the truth of this story, the body, which had not been properly inspected in the first instance, was ordered to be disinterred It was carefully examined by a surgeon, who was enabled to swear positively, that the pistol must have been fired close to the body of the deceased, and not at a distance; since there were the marks of powder and burning on the wrist. Hence it clearly followed, that the pistol had been discharged during the scuffle, either by accident or in self-defence. The prisoner was acquitted, and the parties who had appeared as witnesses against him, were indicted and convicted of perjury. In the case of *Mr. Pearce*, a surgeon who was tried at the Central Criminal Court, in 1840, for shooting at his wife, and was found insane, it appeared from the medical evidence that the pistol had been fired so near to the person of the prosecutrix, that her dress was burnt and the skin blistered. Mr. Marshall relates that when stationed at Ceylon with troops, a man who had but recently joined the regiment, was placed as sentry in a position, where he was occasionally fired at by the enemy from the surrounding jungle. The man was one day found severely wounded; the calf of his leg was greatly torn; the whole charge of a musket having passed through it. He attributed the wound to a shot from the enemy, but from the skin of the leg being completely blackened by charcoal, it was clear that it must have arisen from the discharge of his own musket. He had inflicted this wound upon himself, in order to obtain a discharge from the regiment. These examples then show, that both the dress and skin of a person who has received a gun-shot wound should be closely examined. The result may be, that the statement given of the mode in which it was received, will be entirely disproved. The case of *M Peytel*, tried in France, in September 1839, presents many points of great interest in relation to the medical jurisprudence of gun-shot wounds. This gentleman was travelling in a carriage, in company with his wife, and attended by a man-servant. The wife and the man-servant were found dead on the road, and the account given by M. Peytel was, that the servant had discharged a pistol into the carriage, and shot his wife, and he had afterwards pursued and killed him. The facts, however, were so suspicious against M. Peytel. that he was charged with the double murder. From an examination of the body of the wife, it appeared, that there were two pistol wounds in the face, which had most probably been produced by two separate pistols. The prisoner alleged, that about nine o'clock at night, when it was dark, he desired the servant to get down in order to relieve the horses. Two minutes afterwards, some man, whom he found to be the servant, approached the carriage-door, discharged a pistol at him, and wounded his wife; but the evidence showed that two weapons must have been used, or at least two different discharges made by a person sitting very near to the deceased, so that the muzzles must have almost touched her face, the eyelashes and skin having been much burnt by the powder. These facts, together with other strong circumstances against him, led to the prisoner's conviction. Dr Ollivier, who appeared in the prisoner's favour, considered that the deceased might have been shot by the servant, and that the two wounds might have been produced by one pistol loaded with two bullets; also, that the marks of burning about the face of the deceased, might be attributed to the wadding, and therefore they afforded no proof that the muzzle of the pistol had, at the time of its discharge, been close to her person. He also contended that the deceased had not died from the wounds. Notwithstanding these ingenious medico-legal arguments, there can be no doubt that the prisoner was very properly convicted. (See Ann. D'Hyg. 1839, p. 339; 1842, i. 368.)

It has been said, that when a bullet is fired near, it commonly traverses; and therefore it has been rather hastily assumed, that where

there is only one external wound, and the bullet has lodged, this is a proof that the piece has been fired from a distance. This inference is, however, erroneous. A bullet may be fired close to the person, and yet not traverse the body, either from its impulsive force not being sufficiently great, or from its meeting with resistance in the body. Many cases might be cited to show, that in the near wounds produced by suicides and murderers, the bullets have not always traversed the body. In suicide, when the piece is discharged into the mouth, the projectile often lodges in some part of the cranium. In the assassination of Mr. Drummond, the pistol was discharged close to the back of the deceased ;—the ball, however, had not traversed, it had lodged beneath the skin in the fore-part of the abdomen. It is then, it appears to me, out of the power of a witness to say, from the mere fact of a bullet lodging or traversing, whether the assassin was far off or near at the time the deceased was wounded. The latter point may be sometimes readily determined by the marks of injury and burning about the skin and dress.

When *several wounds* are found on a body,—can we determine whether they were produced by one or several different discharges? This question was raised in *Peytel's* case, as there were two wounds on the deceased, and the prisoner alleged that the servant had fired but one pistol. M. Ollivier thought that this might be explained by supposing that there had been two bullets in the pistol :—it was, however, affirmed by some military officers and other witnesses, that these wounds had been produced by separate pistols, a fact which overthrew the defence of the prisoner. (Ann. D'Hyg. 1842, i. 368.) It is proper to remark that one ball may produce several wounds on the body ; there will be only one orifice of entrance, but owing to the ball occasionally splitting within the body, and dividing itself into three or four pieces, there may be several orifices of exit. This splitting of balls has repeatedly occurred where the projectile in its course, has encountered an angular surface, or projecting ridge of bone. Dupuytren met with an instance, where a ball, after having struck the ridge of the tibia, divided itself into two parts, which traversed the calf of that leg, and penetrated into the calf of the opposite leg. Thus no less than five wounds were produced in one instance by a single ball ; three of entrance and two of exit. Had this man been found dead, and nothing known concerning him, this singular circumstance would probably have given rise to considerable embarrassment. After a careful examination, a surgeon might have been induced to declare, that this person must have received three distinct shots. A similar effect was observed in another case, where the bullet struck the parietal bone and divided itself into two portions :—one passed out superficially through the integuments, the other penetrated into the brain, and lodged on the tentorium. This fact shows, that the discovery of an exit-aperture, does not always prove that the whole of a projectile has passed out, a matter which may influence the prognosis.

It is not absolutely necessary for the conviction of a party on a

criminal charge of maliciously shooting at another, that the bullets or shot should be produced, or that they should even have been found on a post-mortem examination of the body. In the case of the *Queen* v. *Cottrell,* tried in 1839, the deceased was seen to drop, and his face was covered with blood. On persons going up to him, he was found dead. The medical evidence established, that there was a gun-shot wound in the left eye, leading to the brain, and that this had caused death. The shot could not be found. The prisoner's counsel objected on this ground, that there was no proof of a gun-shot wound having been inflicted: but the judge said, the circumstances were sufficient to warrant the jury in inferring that the deceased had been struck by some substance from the gun, which caused his death; and it was not necessary to prove, whether this had been done by leaden shot or pellets. If it should happen, that no wound was produced by the discharge, there would be a want of evidence as to whether the piece were loaded or not, and the accused would probably escape on this ground, unless he were very near to the party whom he attacked, or the bullet were found. This is a subject which gave rise to much discussion in the case of the *Queen against Oxford* in 1840. By this case, it seems to have been decided, that the proof of a piece being loaded with ball or shot, is not necessary, provided the prisoner were so near to the party when he fired it, that mischief might be done by the wadding or gunpowder only. This, as we shall presently find, becomes occasionally a medical question. When a ball traverses the body, it sometimes happens that the apertures are opposite to each other; although it may not have taken a rectilinear course between them, but have been variously deflected by the subjacent soft parts. This deflection of a ball from a rectilinear course, is especially met with in those cases where it happens to strike obliquely a curved surface, and it is found that where the ball enters and does not pass out, its course is often extremely circuitous, so that it is not always easy to say in what part of the body it may be found. In 1830, I saw at the Hotel Dieu, a boy who had received a gun-shot wound in the scrobiculus cordis; the entrance-orifice was very plainly situated there, but there was an opening at the back, nearly diametrically opposite, out of which the ball had passed, so that it conveyed the impression that the ball had completely traversed the abdomen. There was no sign of collapse or depression, nor any indication of serious injury, and Dupuytren gave an opinion which was afterwards verified, that the ball had not penetrated, but had been deflected beneath the skin, and had taken a circuitous course through the cellular membrane to the back. Many similar facts are recorded. The same deflection may occur even when the piece is discharged close to the body, as in cases of suicide. Mr. Abernethy was once called to examine a man, who had shot himself, as it was supposed, through the head. He found two openings in the scalp, nearly opposite to each other; it was soon perceived, on examination, that the ball had not penetrated the bone, but had followed the curve of the exterior of the cranium to its point of exit.

These deflections of projectiles may occur not merely when they come in contact with bone, but when they meet skin, muscles, tendons, and fasciæ,—the ball then takes its course in the interstices between these different structures. A ball which entered at the ankle, has been known to make its exit at the knee: and another, which entered at the back of the left shoulder, passed down on the inside of the scapula, and was found below the right mastoid process. This deflection of balls by such slight obstacles, has been ascribed partly to the obliquity with which they strike, and partly to the rotatory motion on its axis which every spherical projectile is considered to have. It does not appear to be much connected with the degree of velocity, for the same deviation has been found to occur where the bullet was fired near as well as at a distance. Among the questions connected with this subject is the following.—Whether, when a gun bursts, the projectile would take the direction which it would otherwise have taken, had the piece remained entire? (*The King* v. *Morgan*, Monmouth Lent Ass. 1835.) The prisoner in this case was charged with having fired at the deceased with intent to murder. The gun burst in his hand, and produced upon his person, wounds, whereby he was subsequently clearly identified. It was alleged in the defence, that the gun might have been pointed in another direction, and that the deceased was killed accidentally by the charge becoming scattered at the time the piece burst. The question was very properly answered in the affirmative, for the bursting of a gun is posterior to the impulsive direction given to the charge. The shot found in the deceased's body, proved that the gun must have been pointed and fired at her deliberately, notwithstanding the accidental bursting of the piece.

At one of the trials which took place for an attempt on the life of the Queen, it was asked whether it were possible to determine if a recently discharged gun or pistol had been *loaded with ball or not.* It is impossible to give an answer to this question, merely by an examination of the weapon. The report, if heard, is said to be louder and sharper in the case of a piece loaded with ball, than when it is charged with gunpowder and wadding only. If a piece were fired in a direction, so that the projectile met with any hard or resisting object,—the fact of a bullet having been used would be proved if not by the discovery of a flattened projectile, by the trace of a deep leaden mark in the situation of the part struck. If we can at any time discover two fixed points where the ball has touched a building, without being reflected, it will be easy to determine the situation from which the piece was discharged. A singular example of this kind is stated by Mr. Watson to have occurred at Ayr in 1831. Several shots had been maliciously fired into a church. Some of the bullets traversed a window, making holes in the glass, and struck against a wall on the other side of the church,—a fact plainly indicated by the marks which they left. A straight line carried from these two points, reached a window on the opposite side of the street, from which it was afterwards ascertained, the bullets had been fired.

A witness may be asked—when the gun-shot wound was inflicted, and how long the wounded party *survived* after receiving it. A gun-shot wound undergoes no change for eight or ten hours after its infliction. Our judgment may be assisted by observing what parts are involved, although we cannot always infer from the quantity of blood found near, that the hæmorrhage was an immediate consequence of the wound, or that the whole of the blood was effused at once. We cannot then always deny that the deceased could not have moved or exerted himself in some degree, after receiving it. The exertion thus made subsequently to his being wounded, may actually have caused the fatal hæmorrhage. When it is doubtful whether the wound was the result of *accident, suicide,* or *homicide,* the point may be often settled by paying attention to the situation and direction of the wound. Suicidal gun-shot wounds are almost always directed to a vital part—to the heart or to the brain:—they possess those characters which belong to wounds inflicted near to the body.—the skin is blackened or burnt, the wound wide and lacerated,—the hand which discharged the weapon, often blackened,—and sometimes still grasping the pistol. The ball may or may not have traversed, as that will depend on the momentum which it derives from the charge. (See the case of the *Queen* v. *Thomas,* Brecon Lent Assizes 1845.) The situation in this instance negatived the supposition of suicide. Suicidal gun-shot wounds are seldom situated at the posterior surface of the body, therefore the determination of the point of entrance, if the ball has traversed, is of some importance. The direction of these wounds is probably of less moment than their situation, because the projectile is liable to be deflected.

Accidental wounds also bear the characters of near wounds:—they may touch vital parts, but if the body be not disturbed, the presence or absence of design in the infliction of the wound, is commonly made apparent by the relative position of the body and the weapon. They frequently arise from persons drawing the charges of guns or pistols with the muzzles pointed towards them; and these are situated in front;—at other times they are produced by persons pulling towards them through a hedge, or dragging after them, a loaded gun. In the latter case the wound is behind, and strongly resembles a homicidal wound, although the circumstances under which the body is found generally suffice to explain the matter. In the following case of attempted suicide, the characters of the wound somewhat resembled those which are commonly imputed to homicide. In March 1844, a man was brought to Guy's Hospital, with a large ragged gun-shot wound on the right side of the head, behind the angle of the jaw, and between it and the mastoid process. No slugs or bullets could be found; the direction was from behind forwards, and from above downwards. According to this man's statement, the pistol missed fire three times, but he succeeded in discharging it into his mouth, at the fourth attempt. He lost a large quantity of blood, but after some time, he walked to a table at a distance of five yards, reloaded the

pistol, and discharged it at the back of his head in the situation described. Thus, then, there were two wounds, one homicidal in its characters, and a power of locomotion after the first wound in spite of considerable hæmorrhage. A gun-shot wound in the mouth or temple would seldom be set down to accident, and yet attempts are occasionally made to ascribe to such wounds an accidental origin. The admission of a near wound in the temple occurring from accident, must depend entirely upon the circumstances proved. (See the case *Reg.* v. *Tottenham*, Norfolk Lent Ass. 1845.)

In suicide there is commonly strong evidence of design: in accident, all evidence of design is wanting. Suicides sometimes make use of extraordinary weapons, or use weapons in an extraordinary manner. In a case that was brought into St. Thomas's Hospital, some years since, a young man, employed for the purpose of shooting himself, the case of an Italian iron, in which he had filed a touch-hole. He used a marble for a bullet, and discharged the piece into his mouth. Guns are rarely used by suicides, and when they are employed, the marks of design are commonly apparent:—thus the gun is perhaps found to have been discharged by a piece of string attached to the trigger and the deceased's foot. In one instance a man loaded a gun, and placed the stock and breech in a grate. He then deliberately lighted a fire in the grate, and sat opposite the muzzle. When suicides destroy themselves by guns, the wounds are never situated behind. A wound in the back from a gun, indicates either accident or homicide. Important medical questions sometimes arise out of a case of this kind, for the circumstances under which a dead body so wounded, is found, may entirely forbid the supposition of accident. In the case of the *King against Adams*, tried at the Berkshire Assizes, 1836, in which the prisoner was charged with the murder of his father, the gun-shot wound, which had caused death, was situated in the os occipitis. No weapon was found near: hence there could be no doubt, that this was an act of murder. The prisoner was acquitted; since, although he was seen running from the spot at or about the time of the murder, another gun was heard to be discharged, at the same spot about an hour afterwards; and it was impossible, from a medical examination of the wound, to say at what particular period it had been caused. A somewhat similar case occurred more recently, (the *Queen against Richards*, Warwick Lent Assizes, 1843.) The deceased was found dead, lying on his back, with his gun placed on the front of his body, reaching from his thigh to some inches above his head. On inspection, it was ascertained that death had been caused by a severe gun-shot wound at the back of the right ear. Two surgeons of Birmingham, gave it as their opinion, that from the position of the wound, the body, and the weapon, death could not have occurred from design or accident of the deceased, but might have taken place from the accident of another. The prisoner was acquitted, as there was insufficient proof to connect him with the act.

Did the deceased receive the shot while standing, falling, or lying

down? Was the piece when discharged pointed from the shoulder? These questions can only be answered by reference to the particular circumstances of the case. In general, when a person is shot while standing, and the piece is pointed from the shoulder, the wound is more or less transverse; but due allowance must be made for the deflection of balls after penetration. (The *Queen against Magarity*, Central Criminal Court, July 1841.) Was the deceased shot while running away, or when approaching the person who fired? This question is answered by observing in the case of a traversing wound, in which alone, any difficulty can arise, whether the entrance-orifice be situated in front or behind. A trial took place at the Kent Assizes some years since in which this question was material.

An officer in the preventive service, was charged with having caused the death of a man, by shooting him. The deceased was in company with a strong party of smugglers, whom the prisoner and his men were pursuing. During their retreat, the companions of the deceased fired on the preventive-service men, and there seemed great reason to believe that he was accidentally killed by one of the shots so fired, he being at the time between them and the pursuers. If, however, this had been the case, it was clear that he must have received the gun-shot wound in front, as he himself was in the act of retreating. On the other hand it was uncertain, from the general evidence, whether he had not been shot by the prisoner; because, although it did not appear that shots had been fired by him or any of his party, yet it was proved that in running he tripped and fell, and his gun went off at the same instant, so that it was not impossible that the deceased might have received the mortal wound in this manner. The whole case, therefore, rested on the evidence of the medical witnesses. There were two surgeons, who were examined,—one for the prosecution, and the other for the defence. The witness who appeared for the prosecution, deposed; that he found the body of the deceased traversed by a gun-shot wound, which had caused death from the laceration of an artery, and the consequent hæmorrhage. One of the orifices of the wound was situated in the lower part of the buttock, and the other in the upper part of the groin, so that the latter was higher up than the former. He made an inspection of the body, and in his judgment, the ball had passed through the bones of the pelvis, from behind. Accerding to the opinion of this witness, therefore,the prisoner must have caused the death of the deceased. For the defence, a surgeon in the navy, who, it appeared, had had considerable experience relative to gun-shot wounds, was called. He stated that he examined the body of the deceased, in the presence of the first witness, but he was of opinion that the ball had entered in front, and passed out behind the body. The reasons which he assigned for this opinion were, that the wound in front was much smaller than that situated behind, and its edges were smooth and depressed, or turned inwards; while the opening behind was twice or three times the size of that before, and was ragged and uneven, the fragments of bone lying about the opening, and being partly lodged in the muscles of the buttock. These facts proved to him, most unequivocally, that the ball had entered in front, having, with diminished impetus, torn itself out posteriorly. If the ball had entered from behind, he should have expected that the fragments of bone would not have been carried upwards and inwards into the pelvis, and would not have been lodged about the buttock. The value of this witness's evidence was most materially affected by the cross-examination which he underwent. He then stated, that he did not make an inspection of the body until after it had been already inspected, and sewn up. He did not see the state of the bone itself, and his examination of it was but slight. He admitted that the openings of the wound afforded better evidence than the state of the bone; as also that the bone would certainly be shattered, where

the ball had entered. They both agreed, in the first instance, that the ball had entered in front. No reason was assigned why his evidence afterwards differed so materially from that of his colleague. Dr. Smith, who reports this case, does not say what was the result, and we are, therefore, left in doubt upon which of the two witnesses' opinions the verdict of the jury was based; but if it was found that the prisoner had been the cause of the death of the man, it would have been, upon the evidence, no more than misadventure. The view of the latter witness was, most probably correct, namely, that the ball had entered in front, and that the deceased was shot by his own party;—because the reasons assigned by him, were satisfactory and consistent with all experience on the subject; but his opinion was invalidated by the admission that he had made but a superficial and imperfect examination of the body; as also that he did not see it until it had been inspected, and, therefore, not until the parts had been interiered with by others. The direction of the wound,—its passing from above downwards, and from beforc backwards, also throws a shade of doubt upon its correctness: since, for the shot to have been fired in front, the individual who fired it, must have been much elevated above the deceased, a circumstance which did not appear from the evidence, or a ball could not have taken such a course; while on the other hand, its direction was precisely such as it would have taken, if it had been discharged from the prisouer's gun, since it wes established by the evidence, that he, the prisoner, had fallen, while pursuing, and his gun had bccome then accidentally discharged.

Death is sometimes occasioned by small shot, and here several medico-legal questions present themselves. *Small shot* may act in two ways; 1, it either strikes without spreading, in which case, the discharge is always near the person, and its action is much more dangerous, than that of a single ball, because it produocs extensive lacerations: or, 2nd, it strikes after it has spread, and here the discharge must have been distant, and comparatively little mischief is done. Dr. Lachése ascertained by many experiments, that in order to produce with small shot, a regularly round opening like that resulting from a bullet, the discharge should not take place at a distance greater than ten or twelve inches from the surface of the body. When the distance was from twelve to eighteen inches, the opening made was irregular, and the borders were much lacerated; at thirty-six inches, a central opening was entirely lost, and the surface of the body was covered by shot. The effeet after this was found to depend on the distance, the goodness of the gun, and the strength of the charge; (Ann. d'Hyg. 1836, 386:) but it is in general much scattered over the surface of the body. In this way, we may form an opinion of the distance at which the piece was fired. In the case of the *Queen* v *Chapman*, (Oxford Lent Assizes, 1839,) it was proved, that the deceased had been killed by small shot fired from a gun; that the discharge must have taken place very near, as the shot had not been scattered, and the point of the gun must have been below the level of the wound, as the direction was rather upwards. Two medical witnesses were examined, and both agreed, that the gun, when fired, could not have been pointed from the shoulder, judging from the direction of the wound. It can rarely happen that a circular wound can be made by small shot without the dress being singed or burnt. A wound of this description must not, however, be mistaken for one produced by a bullet.

Small shot is rarely observed to traverse the body entirely, unless discharged so near, as to make a clean round opening; but a single pellet reaching the body may destroy life. Two cases have already been mentioned, one where a young man was killed by a single pellet wounding the fifth intercostal artery. the other where a young girl was killed by a pellet traversing the orbitar-plate and wounding the brain. Such minute wounds might be easily overlooked in an examination of the body. The case of the *Queen* v *Kendrew*, York Winter Assizes 1844, is of some medico-legal importance. The medical evidence was very satisfactory. It was shown to be highly improbable that deceased could have shot himself with small shot from a gun, as the shot were scattered, and there was no round opening. Small shot, even when wounding only the skin of the back superficially, has caused death by tetanus.

It matters not with what the piece is charged,—it is capable, when fired near, of producing a wound which will prove fatal. Thus, a piece loaded with *wadding*, or even *gunpowder* only, may cause death. In all these cases, an impulsive force is given by the explosion; and the substance becomes a dangerous projectile. The lighter the projectile, the shorter the distance to which it is carried: but when discharged near to the body, it may produce a fatal penetrating wound. It is unfortunate, that so much ignorance prevails on this point: for fatal accidents are continually occurring from persons discharging guns at others in sport,—an act which they think they may perform without danger, because they are not loaded with ball or shot. In the case of the *Queen against Race*, (Bury Lent Assizes, March 1840,) it was proved, that the prisoner had killed the deceased by discharging at him, within a few feet, a gun loaded with powder and paper-wadding. This was done out of a joke at a fair. The deceased fell, and died in a few minutes; it was found, that the chest was penetrated, and that the wadding had wounded the left auricle of the heart. In October, 1836, during a boat-race at Greenwich, a gentleman fired a blunderbuss towards a crowd of persons. The piece was charged with powder, and this was rammed down with a kid glove having a metallic button attached to it. A man standing on the shore, at the distance of ten or twelve feet received the charge in his abdomen. The deceased died in twelve hours from hæmorrhage:—the glove was found in the abdomen. In 1838, a girl was killed at Burton-upon-Trent by some boys discharging at her a gun loaded with paper-pellets. Some of these penetrated the body and lodged in the lungs and liver. Dupuytren mentions an instance where, during a quarrel between two men, one discharged at the other, a gun loaded with powder and wadding only, at a distance of about eighteen inches. The man instantly fell dead:—on inspection, his clothes were found torn,—the intestines were lacerated, blood was effused, and the wadding was lodged in the abdomen.

It has been observed, that persons, in attempting to commit suicide, have occasionally forgotten to put a bullet into the pistol; nevertheless

the discharge of a piece into the mouth, has sufficed from the effect of the wadding only, to produce a considerable destruction of parts, and to cause serious hæmorrhage. Fatal accidents have frequently taken place from the discharge of wadding from cannon during reviews. It is not easy to say, at what distance a weapon thus charged with wadding and powder, would cease to produce mischief, since this must depend on the impulsive force of the powder and the size of the piece. Dr. Lachése has ascertained by experiment, that a piece charged with gunpowder only, without wadding, is capable of producing a penetrating wound somewhat resembling that caused by small shot, when the piece is large, strongly charged with powder, and fired within six inches of the surface of the body. This arises from a portion of the powder always escaping combustion at the time of discharge, and each grain then acts like a pellet of small shot. Under any circumstances, a discharge of powder only contuses the skin, producing ecchymosis, and often lacerating it, if the piece be fired near. The dress is burnt and the skin scorched from the globe of flame formed by the combustion of the powder; many of the surrounding particles may be actually driven into the cutis. All the substances here spoken of are considered to be projectiles; and the weapons are held in law to be loaded arms, so long as they are capable of producing bodily injury at the distance from which the piece containing them, is discharged. It may therefore become a question as to the distance at which these light projectiles cease to be harmless. The answer must be governed by circumstances: it will materially depend on the strength of the charge. In the case of *Reg.* v. *Collier*, Abingdon Lent Assizes, 1844, the prisoner was charged with firing a gun loaded with small shot at the prosecutor with intent to do grievous bodily harm. It appeared that the gun was deliberately pointed at the prosecutor, who was then at a distance of from seventy to eighty yards from the prisoner. The shot, which was very small, had marked the clothes, but had not penetrated the skin or inflicted any wound. The defence was that from the slight injury done, the prisoner merely intended to frighten the prosecutor and not to do him any bodily harm. He was found guilty of a common assault. The question was here a delicate one, for had the prosecutor been a few yards nearer, and the pellets touched an exposed part of his body, the result might have been serious. One pellet has destroyed life. (ante, p. 384.)

Among the singular questions which have arisen out of this subject, is the following: Whether a person who fires a gun or pistol at another during a dark night, can be identified by means of the light produced in the discharge? This question was first referred to the class of Physical sciences in France, in 1809, and they answered it in the negative. A case tending to show that their decision was erroneous, was subsequently reported by Foderè. A woman positively swore that she saw the face of a person, who fired at another during the night, surrounded by a kind of glory, and that she was thereby enabled to identify the prisoner. This statement was confirmed by the deposition

of the wounded party. Desgranges, of Lyons, performed many experiments on this subject: and he concluded that on a very dark night, and away from every source of light, a person who had fired the gun might be identified within a moderate distance. If the flash were very strong, the smoke very dense, and the distance great, the person firing the piece could not be identified. The question was raised in this country, in the case of the *Queen* v. *White*, at the Croydon Autumn Assizes, 1839. A gentleman was shot at while driving home in his gig during a dark night. He was wounded in the elbow. When he observed the flash of the gun, he saw that it was levelled towards him, and the light of the flash enabled him to recognize at once the features of the accused:—in cross-examination he said he was quite sure he could see him, and that he was not mistaken as to his identity. The accused was skilfully defended and he was acquitted. Evidence of this kind has, however, been received in an English Court of law. A case is quoted by Paris and Fonblanque, (*Rex* v. *Haines,*) in which some police-officers were shot at by a highwayman during a dark night. One of the officers stated that he could distinctly see, from the flash of the pistol, that the robber rode a dark brown horse of a very remarkable shape in the head and shoulders; and that he had since identified the horse, at a stable in London. He also perceived by the same flash of light, that the person had on a rough brown great coat. This evidence was considered to be satisfactory.

From the information which I have been able to collect on this point it appears to me there can be no doubt, that an assailant may thus be occasionally identified. It is widely different, however, in respect to the following case referred to by Müller in his physiology; namely, where a man declared, that he recognized a robber through the light produced by a blow on his eye in the dark! As Müller observes, this is a clear impossibility; because the flashes thus perceived, are unattended with the emission of light, and therefore can never be visible to any other person than the subject of them, nor is it possible that they can ever make any other objects visible. For some remarks on this subject by Dr. Schilbach, see Henke's Zeitschrift der S. A. 1842, i. 197. Dr. Krügelstein has lately opposed the inference deduced by Müller, and has supported his views by cases, which however do not appear to me to be satisfactory. (Henke's Zeitschrift der S. A. 1845, iii. 172.)

An attempt has been made by French medical jurists, to determine for how long a period, a gun or a pistol lying near a dead body may have been discharged; but it is out of our power to lay down any precise rules on such a subject. All that we can say is, a quantity of sulphuret of potassium, mixed with charcoal, is left adhering about the barrel of the piece, when *recently* discharged; and this is indicated by its forming a strong alkaline solution, with water, evolving an odour of sulphuretted hydrogen, and giving a deep black precipitate with solution of acetate of lead. After some hours or days, according to

the exposure to air and moisture, the saline residue becomes converted to sulphate of potash, forming a neutral solution with water, and giving a white precipitate with nitrate of lead. If the piece have been discharged for a considerable time, oxide of iron with traces of sulphate may be found. (See Ann. D'Hyg. 1834, 458—1839, 197. 1842, 368.)

CHAPTER XXXVII.

ON BURNS AND SCALDS. BURNS FROM CORROSIVE LIQUIDS. SPONTANEOUS COMBUSTION.

A BURN is an injury produced by the application of a heated substance to the surface of the body; while a scald results from the application of a liquid at or near its boiling point, under the same circumstances. There seems to be no real distinction between a burn and a scald, for the injury resulting from boiling mercury or melted lead might take either appellation. Neither of these injuries appears to be considered as a wound in law, but in the statute of wounding, they are included among bodily injuries dangerous to life. (1 Vic. 85, sec. ii.) Burns and scalds are *dangerous to life* in proportion to the extent of surface which they cover as well as the depth to which they extend. The extent of surface, involved in a superficial burn, is of greater moment than the entire destruction of a small part of the body through an intensely heated solid. When the burn is extensive, death may ensue either from the intensity of the pain produced, or from a sympathetic shock to the nervous system. Death takes place rapidly from burns, in children and nervous females: but in adults and old persons, there is a better chance of recovery. When death has been caused by intense pain, no post-mortem changes have been detected; but under other circumstances, it has been found on inspection, that there were patches of redness on the bronchial mucous membrane, as well as on that of the alimentary canal. The brain has been found gorged, and the ventricles containing an abundance of serosity. The serous liquids of the pericardium and pleura, have also been in larger quantity than natural. In short, besides congestion, there is generally abundant serous effusion in one of the three great cavities, especially in the cranium. (See cases by Mr. Long, Med. Gaz. xxv. 743; also, by Mr. Erichsen, xxxi. 551.) If the person survive the first effects, he may die from inflammation, suppuration, gangrene, irritation, fever, or he may be worn out by exhaustion. In some instances, especially in children, stupor and insensibility have supervened, owing to a sympathy with the brain; and these symptoms have been followed by coma and death. If, under these circumstances, opium has been given to the patient as a sedative, the stupor resulting from the burn, may be attributed to the effects of the drug; and should the person die,

the practitioner may find himself involved in a charge of malapraxis. It may be alleged, as in the following case related by Mr. Abernethy, that the person was poisoned by opium. A medical man was charged with the manslaughter of a child by giving to it an overdose of opium, when it was labouring under the effects of a severe scald. Mr. Abernethy stated in his evidence, which was given in favour of the practitioner, that he thought the exhibition of opium very proper:—that the quantity given, eight drops of tincture of opium immediately after the accident, and ten drops, two hours afterwards, was not an overdose for a child; (the age is not stated.) The circumstance of the child continuing to sleep until it died, after the exhibition of the opium, was no proof that it had been poisoned. This sleep was nothing more than the torpor into which it had been plunged by the accident. The surgeon was acquitted. Notwithstanding the favourable opinion expressed of this plan of treatment, it would be advisable to avoid the use of opium on these occasions, in respect to young children. We have elsewhere seen, how readily life is destroyed by the smallest doses of this drug; and there are no satisfactory means of distinguishing the comatose symptoms produced by a burn or scald, from those produced by an overdose of opium.

Did the burning take place *before or after death?* The production of *vesication* or of blisters containing serum, is commonly regarded as an essential character of a burn which has been produced during life. Vesication is especially seen in scalds, or where the skin has been burnt by flame, or by the ignition of the clothes. It is not so commonly observed in burns, produced by intensely heated solids. In vesication, the cuticle becomes raised from the true skin beneath, and is converted into one or more blisters containing serum, while the skin around is of a deep red colour. It is very uncertain as to the time at which it appears; it may be produced in a few minutes, or sometimes not for several hours; thus, death may take place before vesication occurs, and the non-discovery of this condition, does not warrant the opinion, that the burn could not have taken place during life. If the cuticle be removed from a vesicated part in the living body, the skin beneath will become intensely reddened; but if the cuticle be stripped off in a dead subject, the skin will become hard, dry, and of a horny-yellow colour; it does not acquire the intense scarlet injection which is acquired by the living skin, under the same circumstances. When vesication is met with, is this certain evidence that the burn was vital,—that it took place during life? This question is of some importance in legal medicine. The following are, I believe, the facts, which have been hitherto ascertained. When boiling-water is poured upon the dead body ten minutes after death, the skin is simply ruffled and shrivelled; but the cuticle does not become raised into a blister. (Christison.) At a longer period than ten minutes, the same effects have been observed while the body retained its warmth. What the effect would be within a shorter period than ten minutes after death, it is not possible to say; nor is it likely that any experiments can be

easily performed to determine this point. It is not probable, however, that vesication would follow after active life, indicated by the continuance of the functions of respiration and circulation, had ceased, except under circumstances to be presently stated. Dr. Christison, on one occasion, had an opportunity of trying the experiment on the same subject before and after death; it was in the case of a young man who had poisoned himself with opium. While he was lying in a hopeless state of coma, four hours before death, a hot iron was held on the outside of the hip-joint; and half an hour after death, a red-hot poker was applied to three places on the inside of the arm. Vesication followed the burns in both instances; but those caused during life contained serum, and those formed after death, air. In another experiment, a cauterizing iron produced no blisters on a leg, half an hour after amputation; but vesications, containing air, were formed, when the iron was applied in another case, ten minutes after amputation. On the whole, Dr. Christison thinks, that a vesication containing serum, indicates a vital, and one containing air, a post-mortem burn. I have performed many experiments on the bodies of infants eighteen and twenty hours after death, both with boiling water and heated solids; but in no case have I observed any kind of vesication to follow at that period. The skin became shrivelled, and was partly destroyed by the heat, but there were no blisters produced. (See case by M. Ollivier, Ann. D'Hyg. 1843. i. 383.) It has been ascertained, that under certain states of the body, blisters containing serum may be caused in the dead subject, even twenty-four hours after death. M. Leuret observed, that this took place in an anasarcous subject, in the vicinity of which a heated brazier had been placed. The cuticle became hardened, then raised and blistered; and the blister contained an abundance of reddish-coloured serum. In repeating this experiment on other dead bodies not infiltrated, vesications containing serum were observed to follow. (Ann. d'Hyg. 1835, ii. 387.)

In burns produced by red-hot solids, other effects besides vesication follow. The edge of the skin around the part burnt, is commonly of a dead white; and close to this, is a *deep red line*, gradually shaded off into the surrounding skin, which is reddened. The diffused redness is removable by pressure, and disappears with life; the red line, however, is not removable by pressure, and is persistent after death. This line of redness is not always met with in severe burns; and when the individual survives one or two days, its production appears to depend on a power of reaction in the system. Thus, then, its absence furnishes no proof of the burn having a post-mortem origin; for it is not a necessary accompaniment of a vital burn. Dr. Christison has endeavoured to determine by experiment, whether this line of redness could be produced by applying a heated solid to the dead subject. He found that when the person had only been dead ten minutes, no such effect was produced. In repeating his experiments on dead subjects many hours after death, I have found that no line of redness ever presented itself, so that its discovery in a dead body burnt, would appear

to indicate either that the burning took place during life, or within ten minutes after death, most probably the former. When, however, vesication and a line of redness are absent, we have no medical data on which to found an opinion as to whether the burn was caused before or after death. In the case of a *Mr. Westwood,* who was murdered in June, 1839, the fact of certain burns found on the body, having been produced during life, was determined by Mr. J. G. French, from an observance of this sign. The deceased was found dead with his skull extensively fractured, his throat cut, and his body burnt in various places. Mr. French, who gave evidence on this occasion, remarked, that the burns were surrounded by a line of redness :—that they were probably produced about the same time as the other injuries, but certainly while there was some vital action in the system.

After murder has been perpetrated, it is not uncommon for a murderer to attempt to dispose of the body by burning it. This was remarked in the case of Mr. Paas, (the *King* v. *Cook,*) likewise in the case of the *Queen* v. *Good,* and in a still more recent case at Leeds, (Jan. 1843,) where a mutilated body was found floating in a river with marks of burning about it. In general, the body is not burnt until all signs of life have disappeared; we shall therefore meet, in such cases, with nothing but the charring of dead flesh, so that no difficulty can exist in forming an opinion. When the burning is partial, and has probably taken place from a wilful ignition of the clothes, at or about the time of death, some caution is required in expressing an opinion, since marks of vesication and a line of redness, are not always present in vital burns. It is by no means unusual, however, to find it stated in evidence, that blisters are a constant accompaniment of a burn in the living body! In the case of the *Queen* v. *Taylor,* (York Lent Assizes, 1842,) the deceased was found dead with marks of strangulation on her neck :—her clothes were much burnt from her waist to the knees. She was lying across the hearth,—the body was much burnt as well as the upper and lower extremities and the neck; in the opinion of the medical witness, the burn on the neck could not have been produced by the fire extending from the other parts of the body. In cross examination he stated that the burns must have been done after death : they could not have taken place before, nor at the time of death, because there was no vesication, and he had never seen a burn on a living person which was not followed by blistering! The prisoner was convicted, the counsel having failed to prove or render it probable that death was caused as alleged by accidental burning.

The conclusions which it appears to me, we may draw from the foregoing statements, are: 1, that when we discover marks of vesication, with serous effusion, or a line of redness or both, about a burnt part of the body, we are justified in saying, that the burn must have occurred during life; 2, that when these appearances are not met with, it by no means follows, that the burn was not vital; the affirmative evidence derived from such appearances being much stronger than the negative.

Whether a burn or a scald was or was not sufficient *to account for death*, must be determined by the extent, depth, and situation of the injury; but even where the burn has clearly been caused during life, the body should be carefully examined for other marks of violence, as blows about the head;—for wounds, marks of strangulation, and internally for hæmorrhage, disease, or poisoning. It must be remembered, that in burns which are rapidly fatal, the serous exhalation of cavities, has commonly a red colour, and the mucous membranes are also reddened. It is very rare that murder is perpetrated by burning; the dead body is either burnt for the purpose of entirely destroying it, or the clothes are fired soon after a person has been killed, in order to conceal wounds or other violent means of death, and to make it appear that the deceased had been accidentally destroyed by fire. Death by burning is either the result of accident or homicide, most commonly the former; but medical evidence may give rise to a suspicion of murder under two circumstances: 1, when it is evident that several parts of the body have been fired at the same time, and the burns are such as not readily to be explained by the same accident, or by the accidental ignition of the clothes; 2, when there are marks of homicidal violence on the body,—these marks, if we except fractures of the bones, may be easily effaced when the burn is extensive. Accidental deaths from this cause are very common among females and young children. Out of 4,671 violent deaths in 1838-9, in the metropolis and the mining districts, there were 962 from burning and 201 from scalding. In investigating a suspicious case, we must remember that the fact of the dead body not being found near a fire or any substance capable of causing ignition, does not justify an imputation of murder; since the deceased, unless disabled by intoxication, infirmity, or disease, has the power of running away from the fire after an accident, and may be found dead at a distance, without having been seen by any person. Homicidal burning cannot be established by medical evidence, so much as by that which is presumptive or circumstantial; but there are many medical questions which arise out of the circumstances under which a body is found burnt. Among reported cases, the two following may serve to illustrate the difficulties attending such investigations.

The first is that of a man of the name of *Gilchrist*, who was tried at Glasgow, for the murder of his wife. The prisoner and the deceased, according to the evidence, led a somewhat rambling dissipated life. On the evening of the alleged murder, the persons who lived on the floor above them, stated that they heard a noise like that of two persons struggling, and afterwards a moaning as of one choking or bleeding to death. A smell of fire now became perceptible in the house, which was soon filled with smoke. The witnesses being alarmed, went down to the prisoner's apartment and demanded admission. After some delay he admitted them, and in doing so, appeared to them to have come out of an inner room where he said he had been sleeping. On letting them in, he stumbled over the body of his wife who lay in the outer apartment quite dead, kneeling before a chair, and very much burnt. The prisoner was accused of having murdered her and then burnt the body to conceal the manner of death. In his defence, he alleged that he had gone to bed tired, and that he knew nothing of what had hap-

pened to his wife until awoke by his neighbours. He presumed that her clothes had caught fire while she was intoxicated, and that she was thus accidentally burnt. The medical witnesses who examined the body reported that they found it so much burnt that they conld give no opinion of the cause of death. The prisoner was condemned and executed, the general evidence being against him, although the precise manner of his wife's death, as Dr. Duncan observes, was not proved even presumptively. In the second case which occurred at Leith, Dr. Duncan was the chief medical witness. The general evidence was similar to that adduced in the case of Gilchrist, but stronger against the prisoner. It appears that he and his wife lived on bad terms. On the night of the alleged murder, the prisoner was in bed, when his wife returned home with a lighted candle and some whiskey, which she had procured at a neighbour's. Some time after, a struggling was heard in the apartment, and when this had subsided, a smell of fire was perceived to issue from it. The neighbours now endeavoured to obtain admission by knocking at the prisoner's door, but he either could not or would not hear them. At last a man forced his way in, by breaking the window of the outer room. On entering, he found the room full of smoke, and something burning in a corner, over which he instantly threw a pitcher of water:—this proved to be the body of the deceased. Several persons now entered the inner room, where they found the prisoner either asleep or feigning to be so. On being roused and told that his wife was dead, he expressed neither surprise nor sorrow; but coolly demanded by what authority his neighbours had broken into his house, and threatened to send for a constable to commit them. On an examination of the body, some parts were found completely carbonized by the action of the fire. On the face and extremities, however, the fire had not acted with such violence, and on these parts were found marks of vital reaction indicating that the burning had taken place during life. Some spots were merely red and inflamed, others scorched to a hard transparent crust but surrounded by a distinct redness: there were also many vesications filled with lymph. From these appearances, the witnesses gave it as their opinion that the deceased had been burnt to death. The jury in this case returned a verdict of not proven, consldering probably that the deceased might have been accidentally burnt. Dr. Duncan remarks, in regard to these two cases, that the action of the fire was extremely violent and destructive compared with the small quantity of combustible matter consumed. In both, the burns must have been produced by the ignition of the clothes alone, since there was no trace of burning of the house or furniture in either. In the second case, the deceased was found on the hearth with part of her clothes unburnt, and a chair from which she had fallen, quite entire. She was dead when the neighbours entered: and the body was discovered in the dark by the red light issuing from it.

An important question was raised on the second trial, in reference to the opinion of the deceased having been burned to death, namely, whether the redness and blisters, remarked on the edges of the scorched parts, might not have arisen immediately after strangling or some other cause of death than burning, during the period when a lingering vitality remains in the body, and when undoubtedly certain phenomena of a vital nature, are frequently observed. The medical witnesses felt themselves unable to answer the question decisively, but they stated that they did not consider it at all probable that blisters could be produced on the body even immediately after death. (Med. Gaz. viii. 170. See case by M. Leuret, Ann. D'Hyg. 1835. ii. 370.)

Supposing that a dead body is found burnt, and there is no other cause of death about it; it may be said that the burning was neither the result of accident nor of homicide, but that it was the effect of spontaneous or human combustion.

Human combustion.—There are two opinions concerning this so-called spontaneous destruction of the human body. On the one hand,

Spontaneous Combustion" an Article in Blackwood's Edinburgh Magazine Vol. XXXIX. No. CCXLVI April 1861

some allege that the combustion may take place from internal causes,—in other words, that the process is literally *spontaneous*: on the other hand, it is contended that the contact of a substance in a state of ignition, is necessary for the production of the phenomenon,—so that according to this view, the human body merely becomes preternaturally combustible. The hypothesis of those who advocate *spontaneous* combustion, is, it appears to me, perfectly untenable. So far as I have been enabled to examine this subject, there is not a single well-authenticated instance of such an event occurring:—in the cases reported which are worthy of any credit, a candle or some other ignited body has been at hand, and the accidental ignition of the clothes was highly probable, if not absolutely certain. It is in vain that they who adopt this hypothesis, appeal to the electrical state of the atmosphere or of the individual, coupled with the impregnation of the system with the inflammable principles of alcohol, as conditions sufficiently explanatory of their views,—such explanations may be reserved until the occurrence of this spontaneous combustion from internal causes, is placed beyond all dispute. For a full description of the phenomena which are said to accompany this condition, see Casper's Wochenscrift, 1841, Nos. 8, 9, 10; also, Henke's Zeitschrift der S. A. 1842, ii. 228; 1843, ii. 39. We will now then consider, how far the views of those who allow that the body may acquire preternaturally combustible properties, are consistently borne out by facts. It is generally admitted that the human body is highly difficult of combustion; and therefore, if in any case, the degree to which it is consumed by fire is great in proportion to the small quantity of combustible matter destroyed about the person, it is not unreasonable to refer this to its possessing greater combustible properties. This is precisely the species of evidence which is furnished by the alleged cases of spontaneous combustion: the body has been found almost entirely consumed, and the clothes and other articles of furniture surrounding it, but little injured. A similar remark was made by Dr. Duncan, respecting the two cases just now related, in which the husbands were tried for the murder of their wives: in both it was the opinion of this physician, that the bodies of the deceased were preternaturally combustible.

Without attempting to offer any explanation of the fact, there appears to be sufficient evidence on record, to bear out the view that the human body may, under certain circumstances, acquire increased combustible properties. At the same time, the medical jurist will perceive that this admission does not involve any difficulty in the judicial determination of a question of murder by burning, since it is contended that the combustion of the body cannot take place, except by contact with ignited substances. But whether the ignition of the clothes of a deceased person took place accidentally, or by the criminal act of an accused party, is a totally different question,—it is one in which a medical jurist is no more concerned than a non-professional witness,—this is, in fact, a point which can only be cleared up by general or circumstantial evidence. If it be admitted that the body of one person

will burn more rapidly and completely than that of another, this will be no ground of exculpation to a prisoner, who is proved to have wilfully set fire to the clothes of that person. It may be urged in defence, that the prisoner might not have intended to destroy the deceased; and that, although he ignited the clothes, he did it without any malicious intention; and that death would not have been caused by his act, but for the preternatural combustibility of the body of the deceased! The intention which a person may have had in setting fire to the clothes of another, when he could not possibly know to what degree the burning would extend, is, of course, a question for a jury, to be decided from the circumstances. The relation of this subject of the alleged spontaneous combustion of the body to medical jurisprudence, appears therefore to have been much exaggerated. The only credible part of the doctrine, can never present any sort of difficulty to a medical jurist.

When *several burns* are found on a dead body, it may be a question, whether they were all produced at the same time. This is a point which can be determined only, by observing whether any of them present signs of gangrenous separation:—of suppuration,—granulation, or other changes that take place in a living body after accidents of this kind. The witness may be asked, how long did the deceased survive the burn? A person may die in a few minutes or live some hours after receiving a most extensive burn; and yet there will be no changes in the part burnt, to indicate when death actually took place. There may have been no time for inflammation or its consequences to become established. Suppuration generally follows vesication; and in severe cases, it may occur by the second or third day; but often not until a later period. In regard to gangrene;—this takes place, when the vitality of a part burned, is destroyed. The time of its occurrence is uncertain, but it sometimes very speedily follows the accident.

Burns by corrosive liquids.—Among the cases in which medical evidence is sometimes required, are those of throwing sulphuric acid or other corrosive liquids on the person. This crime has been especially prevalent of late years, and until the recent alteration in the criminal law, there was no adequate punishment for it. On one occasion, the prisoner escaped the charge of felony, because it could not be considered in law, that sulphuric acid was capable of producing a wound—the man having been indicted for wounding! This case clearly showed a strong necessity for some legal definition of a wound, as well as the uncertainty of medical opinions; for while one surgeon considered that the injury produced was a wound, another thought that it was not. The judges decided that it was not a wound within the meaning of the statute. (The *King* v. *Murrow*, Liverpool Aut. Assizes, 1835.) The act 1 Vic. c. 85. s. v. while it punishes the offence, omits all reference to the definition of the word wound. The nature of the liquid thrown, is merely defined in general terms to be "any corrosive fluid or other destructive matter"—a point which will require to be

settled by medical evidence. In common language, and according to the statute, the injury thus produced is called a burn; but it is wholly different in its origin, as well as in its progress. I do not know that there has been a single instance, in which such an injury has directly destroyed life; but great deformity and actual blindness have resulted. A medical man is sometimes required to distinguish these injuries from burns and scalds:—this may be easily done in the first instance, by the appearance of the part injured, as well as by the description of the first symptoms. The skin touched by a concentrated acid is destroyed and sloughs away, leaving a suppurating and granulating surface. The period of recovery will depend on the extent of the injury. Although a person may not die from the direct effects of the acid, yet in certain irritable constitutions, the inflammation which follows might prove fatal. In young infants, or delicate nervous females, an extensive injury thus produced, may, however, readily destroy life. In the case of *Miss Cashin*, for whom an escharotic liniment was prescribed by a quack, there was no doubt, that death was caused by the great local mischief produced by the application.

The nature of the acid may be determined by applying wetted linen to the part when the injury is recent, and examining the liquid thus absorbed. In general, however, evidence is readily obtained by examining the spots or stains left on articles of clothing or furniture. Sulphuric acid is most commonly used; but a case has been elsewhere referred to where nitric acid was employed, and led to the destruction of the sight of one eye. The caustic alkalies might also be used under these circumstances, and numerous other liquids on which the only medical opinion required would be, whether or not the liquid employed, should be considered as corrosive or destructive matter. To constitute a felony, it is necessary that the person should have sustained from the act of throwing, some grievous bodily harm. The mineral acids are sometimes used in other ways for the destruction of life. In June, 1833, a man poured a quantity of strong nitric acid into the ear of his wife while she was lying asleep. She awoke suddenly with a violent pain in the ear, which continued for three days, whereby she became weak and exhausted. Soon afterwards there was copious hæmorrhage, and a portion of membrane escaped. She lost the use of her right arm, and became perfectly deaf. Suppuration took place from the ear, and blood escaped daily. She gradually sank and died, six weeks after the injury, the right half of the body being convulsed before death. On inspection, a portion of the external ear was wanting, and the meatus was much wider than natural. The brain, near the petrous portion of the temporal bone, was softened and the bone itself carious. The injury had led to death indirectly, by producing disease of the brain. (Med. Gaz. xvii. 897.)

Spontaneous combustion.—Although we have seen that there is no proof of such a phenomenon as the spontaneous combustion of the living body, it must be admitted that by a reaction in the particles of

organic or inorganic matter, combustion may take place independently of the approach or contact of an ignited substance. We are not now speaking of those effects that result from the admixture of bodies by chemists, with which every one, who has devoted but a slight attention to chemical manipulation, must be familiar,—but of certain other phenomena which, although assuredly dependent on, and explicable by the same laws, are far less commonly understood, and have only lately received any attention from the scientific inquirer. Let us suppose a case;—In a floor-cloth manufactory,—in a granary, or storehouse, a fire may suddenly break out and spread through the whole building with destructive energy,—it is pronounced to be the act of an incendiary,—a person known to have harboured ill-feelings against the proprietors, is seen coming from the spot just before the occurrence of the fire,—some careless expressions and a few apparently strong points of circumstantial evidence are adduced against him, he is tried, condemned, and executed. It is here then, that a medical jurist is called upon to step forward and employ his science, not to shield a criminal, but to see that a human life is not sacrificed on a groundless charge. Should any individual be consulted on such occasions, it will undoubtedly be the medical practitioner, and the examination of this subject, therefore, must form a part of his duties: a slight reflection will teach him, that there is no member of society who ought to be so competent as himself to solve the questions which may arise. We have yet much to learn respecting the cause of this spontaneous combustion of bodies, for hitherto only a few isolated facts have been collected, some of which, however, are so striking and unprecedented, as to lead to the presumption that there exist many unsuspected substances which are capable of undergoing this singular change.

Towards the latter part of the last century, several fires occurred in the Russian navy, as well as in the warehouses on shore, which were at first attributed to incendiarism, but which were subsequently discovered to be owing to the spontaneous inflammation of masses of *hemp* and *flax* impregnated with oil. Experiments were made on the subject by the Imperial Academy of Sciences, and it was shown to the satisfaction of the Russian Admiralty, that such materials when heaped together and allowed to remain for some time with a full access of air, would spontaneously ignite. Paris and Fonblanque, (vol. i. p. 410.) The great fire in Plymouth dockyard in 1840, was supposed to have arisen from a similar cause, although there was a strong suspicion that it was the act of an incendiary.

Cotton impregnated with oil will also undergo spontaneous combustion. An accident of this kind occurred at New York in 1832, by which a ship and her cargo were nearly destroyed, owing to the spontaneous ignition of some bales of cotton on which oil had become spilled. But cotton of itself is capable of igniting, when packed too early and before it is thoroughly dry. It was to this that the destruction of a ship in September 1834, was owing. The captain informed me that the cotton which he had on board, had been brought down to

Bombay during the wet season,—that no attempt was made to dry it properly before shipping it, and that in this state, it was closely packed between decks, as well as in every spare part of the vessel. About a month after leaving the port, the crew were alarmed by an abundance of vapour issuing from the fore-hatchways. The vapour became more dense, and assumed the character of a thick smoke. Several bales of cotton were removed, but the danger became thereby increased, owing to the free current of air created, and in a very few hours the deck caught fire. The ship was then abandoned, and its total destruction speedily followed. Many similar accidents from cotton have occurred since that time. See Ann. D'Hyg. 1842, 211. 1843, 99. It is well known that in the stacking of hay, if the grass is cut and stacked too early, combustion will almost inevitably follow,—this seems to be a phenomenon similar to that just described.

Another substance exposed to this singular condition is charcoal, especially in that form of it called *Lamp-black.* A few years since, a ship laden with some lamp-black, in casks, sailed from Portsmouth. In about six weeks afterwards a strong smell of burning was perceived to issue from the fore-hold, accompanied by smoke. On examination, it was found that a large cask of lamp-black was giving out volumes of smoke, although not actually in flames. It was with some difficulty, owing to the intense heat of the cask, that it could be got on deck and thrown overboard; in this case, it was presumed that the admission of air to the interior of the cask would have caused its instant ignition. In consequence of this discovery the whole of the lamp-black on board, to the number of sixty-one casks, was thrown into the sea, and several of them were observed to be in a state of smothered combustion; the casks were surrounded by a number of barrels of tar, and jars of oil, but it did not transpire whether any of these inflammable substances had become mixed with the contents. No light had been allowed in the hold since leaving England,—it was therefore a clear instance of spontaneous combustion.

The cause of this phenomenon in *Charcoal* is not well understood. The following facts we derive from the experiments of M. Aubert. When recently-made charcoal is reduced to a very fine state of division, it rapidly absorbs air and aqueous vapour, especially the former. The air undergoes no change up to the moment at which combustion ensues, but a considerable quantity of heat is extricated, which this experimentalist found at one time to be equal to 350° F. The greatest degree of heat was observed to be in the centre or about five or six inches below the surface, and it appears that ignition first commences here, if there be a tolerably free access of air. M. Aubert found that the most inflammable charcoal required to be in masses of at least sixty pounds, for inflammation to take place spontaneously, and the less inflammable the charcoal, the larger the quantity required to be collected in a heap. In all these cases the charcoal was pulverized, and the shorter the time suffered to elapse between its manufacture and its pulverization, the

more certainly and rapidly did ignition take place. Air is not only necessary for the spontaneous inflammation of this substance, but there must be a free access of it to the surface of the mass.

For a knowledge of another body, largely existing in certain manufactures, possessing the property of spontaneously igniting, we are indebted to Mr. Scanlan. (Records of General Science, August 1835.) In March 1835, a fire broke out in a turpentine distillery, at Dublin. The fire was confined to what is termed by turpentine distillers *Chip-cake*, and it could only be attributed, under the circumstances, to the act of an incendiary or to the spontaneous ignition of this substance. The raw American turpentine, as it is imported, contains many impurities in the form of chips of wood, leaves and leaf-stalks. These impurities are commonly separated by heating the turpentine to about 180° and straining it,—the mass thus separated (which is subsequently exposed to a temperature of 212°) is called chip-cake : when thus obtained, it has not been known to undergo spontaneous combustion. On the occasion above-mentioned, a new plan had been adopted by the manufacturer. The raw turpentine with its impurities was exposed at once to a temperature of about 250°, and the boiling rosin was then strained from the chips. The chip-cake from this process, was laid in a heap outside the still-house about three o'clock in the afternoon, and at midnight was observed to be in flames. Mr. Scanlan found, in making his observations upon a portion of chip-cake thus prepared, that the temperature gradually increased towards the centre of the heap, although on the exterior, it was cold and brittle : in four hours a thermometer rose to 400°, and a large quantity of vapour, accompanied by a strong odour of pitch and rosin, was extricated. The exposure of the mass experimented on, took place at one o'clock in the afternoon, and although it rained hard during the night, at half-past seven the following morning it burst into a flame. Three experiments were made and were attended by similar results,—in the third, the porous heap appeared to become red-hot in the centre, so that the adhering rosin melted and dropped from beneath.

In the same paper, this gentleman mentions that a friend of his, who had placed a quantity of *Red fire* in a store-room, was surprised by its spontaneously igniting and becoming entirely consumed the following day, while he was in an adjoining apartment. This powder is much used in theatres for the production of artificial light,—it is a mixture of nitrate of strontian, sulphur, sulphuret of antimony, chlorate of potash and charcoal : this I believe is the only instance on record of its spontaneous combustion. It has been a question, whether the lucifer matches which are now so extensively sold, are not subject to spontaneous ombustion. Some of these matches arc luminous in the dark, but I have exposed them to a temperature of 120° without ignition. When many are collected together, the heat given out by slow combustion might possibly become accumulated. One fact is certain, that many kinds of these matches, will ignite with the slightest friction, and may thereby occasion alarming accidents. (See Ann. d'Hyg.

1841, 309.) I have observed the spontaneous ignition of oxide of phosphorus, as well as of some chemical compounds of the metals which had been accidentally thrown aside. Other facts might be quoted relative to the spontaneous ignition of substances, which are not commonly supposed to possess such a property; but I think enough has been said to induce a medical jurist to give his attention to this curious phenomenon, and on a charge of incendiarism, founded on mere presumption, to act as the defender of an accused party,—should the facts of the case warrant the belief, that the fire had originated from any of these secret operations of nature.

INFANTICIDE.

CHAPTER XXXVIII.

GENERAL REMARKS. DETERMINATION OF THE AGE OR MATURITY OF THE CHILD.

By infanticide we are to understand in medical jurisprudence, the murder of a new-born child. The English law, however, does not regard child-murder as a specific crime; it is treated like any other case of murder, and is tried by those rules of evidence which are admitted in cases of felonious homicide. In saying that infanticide is the term applied to the murder of a *new-born* child, it is not thereby implied that the wilful killing should take place within any particular period after birth. Provided the child be actually born and its body entirely in the world, it matters not whether it has been destroyed within a few minutes or not until several days after its birth. In the greater number of cases of infanticide, however, we find that the murder is commonly perpetrated within a few hours after the birth of the child. Although the law of England treats a case of infanticide as one of ordinary murder, yet it is to be observed that there is a particular difference in the medical evidence required to establish the murder of a new-born child. It is well known that in the course of nature, many children come into the world dead, and that others die from various causes soon after birth. In the latter, the signs of their having lived are frequently indistinct. Hence, to provide against the danger of erroneous accusations, the law humanely presumes that every new-born child has been born dead, until the contrary appear from medical or other evidence. The onus of proof is thereby thrown on the prosecution; and no evidence imputing murder can be received unless it be made certain by medical or other facts, that the child survived its birth, and was actually living when the violence was offered to it. Hence there is a most difficult duty cast upon a medical witness on these occasions.

In cases of child-murder, medical evidence is commonly founded upon an examination of the body of the child; but it must be borne in mind, that a woman may be found guilty of the crime, although the body of the child be never discovered:—it may have been destroyed

by burning or otherwise disposed of, and a medical witness may have only a few calcined bones to examine. (Ann. D'Hyg, 1845. ii. 129.) In these cases of the non-production of the body, good legal evidence of the murder would, however, be demanded; and this evidence should be such, as would satisfactorily establish a matter of fact before a jury. The production of the body of the child is therefore no more necessary to conviction than in any other case of murder. A woman has been tried within the last few years for the murder of her child, the body of which was never discovered.

In most instances, however, the body of the child is found,—an inquest is held, and medical evidence is demanded. In giving evidence at a coroner's inquest on a case of infanticide, as much care should be taken by a practitioner, as if he were delivering it before a judge at the assizes. Some witnesses are disposed to treat an inquest with indifference; and to be careless in their evidence, thinking probably that should the case come to trial, they could prepare themselves and amend any statements which subsequent reflection might show them to have been hastily made before a coroner. But it ought to be known that the depositions taken by this officer, may at the trial, be placed in the hands of the judge and the prisoner's counsel; and should a witness deviate in his evidence at the assizes, from that which he gave at the inquest,—or should he attempt to amend or explain any of the statements then made, so that they might, by the ingenuity of a barrister, be represented as having a new bearing on the prisoner's case, he would expose himself not merely to a severe cross-examination, but probably to the censure of the Court. If medical men were to reflect that in delivering their opinions before a coroner and jury, they are, in many instances, virtually delivering them before a superior Court, it is certain that many unfortunate exposures would be easily avoided.

Age or maturity of the child.—One of the first questions which a witness has to consider in a case of alleged child-murder, is that which relates to the age or probable degree of maturity which the deceased child may have attained in utero. The reason for making this inquiry, is that the chances of natural death, in all new-born children, are great in proportion to their immaturity; and that supposing them to have survived birth, the signs of their having respired, are commonly very obscure. It is found that the greater number of children which are the subjects of these investigations, have reached the eighth or ninth month of gestation; yet charges of murder might be extended to the wilful destruction of children at the seventh month or under, provided the evidence of life after birth were clear and satisfactory. The English law does not adopt the principle which exists in the codes of some Continental states, namely, that a child, in order to become the subject of a charge of murder, should be born *viable*, i. e. with a capacity to live. It is observed by Mr. Chitty, although no authority is quoted for the statement, that "the object of the law is to prevent injuries to infants having capacity to

maintain a separate existence;" and he further suggests that such a capacity should be proved in order to complete the offence of infanticide. (Med. Jur. i. 411.) This argument, carried to its full extent, would render it no offence to put to death all persons afflicted with any mortal disease. I have been unable to find, in the numerous reported trials for infanticide, any ground for this extraordinary doctrine. The capacity of a child continuing to live has never been put as a medical question in a case of alleged murder; and it is pretty certain, that if a want of capacity to live were actually proved, this would not render the party destroying it, irresponsible for the offence. Children may be born alive at the sixth or seventh month, but because they are much less likely to survive than those born at the eighth or ninth month, this is not a sufficient ground of exculpation to any person who wilfully destroys them. The real question, as we shall presently see, does not refer to the period of gestation at which a child may be born, but to the fact of its being living and entirely born when the murderous violence is offered to it.

Although the principle above referred to, is not recognized in English jurisprudence, yet in the following case, which occurred in October 1836, a coroner refused to hold an inquest on the body of a child, because it had not reached an age (seven months) at which children are commonly born alive! In this case there was probably no harm done; but when we consider—1, the great difficulty of determining the exact age of a child from the characters found on its body: and 2, that many children born under the seventh month, have not only been born alive, but have lived to adult age, the acting on a principle of this kind would be likely to give rise to dangerous abuses. It is impossible to admit that children are to be destroyed with impunity because they happen to be born under the seventh month, or that a child should be assumed to have been born dead, and any inquiry into the cause of death dispensed with, unless it can be medically established that it has passed the seventh month of gestation.

Dr. Beck says, "If it can be proved that the child, which is the subject of investigation, has not attained this age, (the seventh month,) no charge of infanticide *can* or *ought* to be entertained." (Med. Jur. 245.) Are we to understand by this that children proved to have been born living before the seventh month, may be wilfully destroyed, and the law take no cognizance of the matter?—if this be not the meaning, the statement amounts to nothing, because whether the child have reached the seventh, eighth, or ninth month, life and live birth must still be proved, before the question of murder can be entertained. I have known an instance of a child born between the sixth and seventh month, living a fortnight, and many similar cases are recorded. On the doctrine above laid down, the deliberate destruction of such children, although actually living, ought not to be considered or treated as murder!

The following are the characters, whereby we may judge of the age of a child from the sixth to the ninth month of gestation.

Between the *sixth* and *seventh*. The child measures from the vertex to the sole of the foot, from eleven to twelve inches, and weighs from two to three pounds. The head is large in proportion to the trunk,—the eyelids are adherent and the pupils are closed by the membranæ pupillares. The skin is of a reddish colour, and the nails are slightly formed;—the hair loses the silvery lustre which it previously possessed, and becomes darker. Ossification proceeds rapidly in the sternum, and in the bones of the tarsus. The brain continues smooth on its surface:—there is no appearance of convolutions. In the male the testes will be found in the abdominal cavity, lying upon the psoæ muscles immediately below the kidneys. Between the *seventh* and the *eighth* month. The child now measures between thirteen and fourteen inches in length, and weighs from three to four pounds. The skin is thick, of a more decidedly fibrous structure, and covered with a white unctuous matter, which now for the first time appears. Fat is deposited in the cellular tissue, whereby the body becomes round and plump:—the skin previously to this, is commonly more or less shrivelled. The nails, which are somewhat firm, do not quite reach to the extremities of the fingers. The hair becomes long, thick, and coloured. Ossification advances throughout the skeleton. Valvulæ conniventes appear in the small intestines, and the meconium is found occupying the cæcum and colon. The testicles in the male are considered about this period to commence their descent, or rather, the child's head being downwards, their ascent towards the scrotum. The time at which these organs change their situation, is probably subject to variation. According to J. Hunter, the testes are situated in the abdomen at the seventh, and in the scrotum at the ninth month. Burns believes that at the eighth month they will commonly be found in the inguinal canals. Between the *eighth* and *ninth* month, the child is from fifteen to sixteen inches in length, and weighs from four to five pounds. The eyelids are no longer adherent, and the membranæ pupillares will have disappeared. The quantity of fat deposited beneath the skin is increased, and the hair and nails are well developed. The surface of the brain is grooved or fissured, but presents no regular convolutions; and the cineritious matter is not yet apparent. The meconium occupies almost entirely the large intestines, and the gall-bladder contains some traces of a liquid resembling bile. The testicles in the male, may be found occupying some part of the inguinal canal, or they may be in the scrotum. The left testicle is sometimes in the scrotum, while the right is situated about the external ring.

At the *ninth* month. (*Maturity.*)—The average length of the body is about eighteen inches, and its weight about six pounds, or between that and seven pounds: the male child is generally rather longer, and weighs rather more than the female. Extraordinary deviations in length and weight, are occasionally met with. Mr. Owens, of Ludlow, has reported a case in which the child at delivery measured twenty-four inches, and weighed seventeen pounds twelve ounces. (Lancet, Dec.

1838.) In a case which I had to examine in June 1842, the child, a male, measured twenty-two inches, and weighed twelve pounds and a half. [For an excellent essay on this subject, by Dr. Ellsässer, see Henke's Zeitschrift, 1841. ii. 235.] At this period, the head of the child is large, and forms nearly one-fourth of the whole length of the body. The cellular tissue is filled with fat, so as to give considerable plumpness to the whole form, while the limbs are firm, hard and rounded. The hair is thick, long and somewhat abundant. The nails are fully developed, and reach to the ends of the fingers ;—an appearance, however, which may be sometimes simulated in a premature child, by the shrinking of the skin after death. The testicles in the male, are generally within the scrotum. Ossification will be found to have advanced considerably throughout the skeleton. (See, in relation to the progress of ossification, some excellent remarks by M. Ollivier. Ann. D'Hyg. 1842. 343.) The surface of the brain presents convolutions, and the cineritious matter begins to show itself. The internal organs, principally those of the chest, undergo very marked changes if the act of respiration have been performed by the child before, during or after its birth.

The relative position of the point at which the *umbilical cord* is inserted into the abdomen, has been considered by some medical jurists to furnish evidence of the degree of maturity. Chaussier thought that in the mature child, at the ninth month, the point of insertion of the cord exactly corresponded to the centre of the length of its body. Later observations, however, have shown that this is not quite correct. Out of five hundred children examined by M. Moreau, at the Maternité, in Paris, the umbilical aperture corresponded to the centre of the body, in four only. In the majority of these cases, the point of insertion was eight or nine lines below the centre; among many cases of mature children, which I have had an opportunity of examining, the umbilical aperture has generally been from a quarter to half an inch below the centre of the body. (Guy's Hospital Rep. April 1842.) M. Moreau found that in some children, born about the sixth and eighth month, the cord was inserted at the middle point of the length. (Lanc. Franç. 1837.) On the whole, it will be perceived that not much value can be attached to the situation of the umbilical opening, as a sign of maturity or immaturity.

The characters which have been here given as belonging to a child at the different stages of gestation, must be regarded as an average statement. They are, it is well known, open to numerous exceptions; for some children at the ninth month are but little more developed, than others at the seventh. Twins are generally less developed than single children;—the average weight of a twin child is not more than five pounds, and very often under this. The safest rule to follow in endeavouring to determine the uterine age of a child, is to rely upon a majority of the characters which it presents. That child only can be regarded as mature, which presents the greater number of the characters already described, and which are met with in children at or

about the ninth month of gestation. Let us suppose that the age of the child has been determined :—whether it be under or over the seventh month, the same rules for a further investigation, will be demanded. Should the child be under the seventh month, the medical presumption will be that it was born dead; but if it has arrived at its full period, then the presumption is, that it was born alive.

CHAPTER XXXIX.

ON THE PROOFS OF A CHILD HAVING LIVED AT ITS BIRTH.

The question whether a child was or was not born alive is of the greatest importance in a case of alleged child-murder; and it is unfortunately one which in respect to the proofs upon which medical evidence is commonly founded, has given rise to considerable controversy. When it is stated that in most cases of alleged infanticide which end in acquittals in spite of the strongest moral presumptions of guilt, the proof fails on this point only, it must be obvious, that this question specially claims the attention of a medical jurist. The medical evidence of a child having been alive, when violence was offered to it at its birth or afterwards, may be divided into two parts; 1, that which is obtainable before the act of respiration is performed; and 2, that which is obtainable afterwards. At present it will be proper to confine our attention to the question whether the child was *alive* when it was maltreated,—the fact of its having been *born* alive, will be a matter for future consideration. These two questions have been frequently mixed together, thus rendering the subject confused; but it must be so obvious as scarcely to require stating, that violence of a murderous kind may be offered to a living child before it is entirely born; and that owing to this violence, it may come into the world dead.

Evidence before respiration.—It was formerly supposed that if the lungs contained no air, the child could not have respired, and that it must have been born dead. But neither of these views is correct :—children have been known to respire faintly, and continue in existence many hours without visibly distending the cells of the lungs with air, —the absence of air from the lungs, therefore, furnishes no proof either that respiration has not been performed, or that the child has not lived. (G. H. Rep. April, 1842.) That our law-authorities will admit evidence of life in a child before the establishment of respiration, is

clear from the decision of Judge Park, in the case of R. v. Brain, in which he said, that a child might be born alive, and not breathe for some time after its birth, (Archbold, Crim. Plead. 367,) as also from the charge of Mr. Justice Coltman in the case of R. v. Sellis, (Norf. Spr. Circ. 1837.) In this instance it was alleged, that the prisoner had murdered her child by cutting off its head. The judge told the jury that if the child were alive at the time of the act, it was not necessary, in order to constitute murder, that it should have breathed. In fact, it would appear that respiration is regarded as only *one* proof of life; and the law will, therefore, receive any other kind of evidence which may satisfactorily show that the child has lived, and make up for the proof commonly derived from the state of the lungs. It will be first incumbent on a medical practitioner to prove, that the child under examination has recently died, or in other words, that there are good grounds for believing it to have been *recently living*. Hence if the body be highly putrefied, either from the child having died in the uterus some time before birth, or from its having been born and its body not discovered until putrefaction had far advanced both internally and externally,—the case is utterly hopeless. The medical witness must abandon it, because the body can furnish no evidence whatever of life after birth. The examination of the internal organs would throw no light on the case, for here we are assuming that the lungs are in their fœtal condition.

The phenomena of putrefaction in air require no notice in this place; but the changes which ensue, when the child dies and is retained within the uterus, may be briefly adverted to, because they may sometimes form a subject for judicial inquiry. According to Devergie, when the child dies in utero, putrefaction takes place as rapidly as in the open air; but this is extremely doubtful. (Méd. Lég. i. 526.) In an advanced state of *uterine putrefaction*, the body of the child is so flaccid, that it becomes almost flattened by the mere gravitation of its parts when placed on a table. The skin is of a reddish brown colour, not green as in a putrefied body exposed to air. The epidermis of the feet and hands is white, and sometimes raised in blisters,—the cellular membrane is filled with a reddish-coloured serum, the bones are moveable and readily detached from the soft parts. In the opinion of Devergie, the principal difference between uterine and atmospheric putrefaction in respect of the body of a new-born child, is seen in the colour assumed by the skin:—but it must be remembered, that should the child remain exposed to air after its expulsion, the skin may acquire the colour seen in cases of atmospheric putrefaction. The changes which have just been described are such as we may expect to find, when the child has been retained in utero, eight or ten days after its death. When it remains for some weeks before it is expelled, the body has been occasionally found saponified and incrusted with phosphate of lime. If in any case we are able to state, that the body of a child has undergone uterine and not atmospheric putrefaction, it is clear that it could not have come into the world alive. Under ordi-

nary putrefaction in air, the child may have been really brought into the world living, and the process may have destroyed every proof of that fact.

Let us suppose that the child died in utero from forty-eight to twenty-four hours before it was born:—if it be soon afterwards examined, there will be no marks of putrefaction about it, and the appearances will closely resemble those met with in the body of a child which has been born alive and died without respiring:—or of one which may not have been born alive, but have died in the act of birth. It will be impossible to say in such a case, whether the child came into the world living or dead. It has been proposed to seek for evidence of life under these circumstances, by observing the characters presented by marks of violence on the body. In general, when children have been murdered, the amount of violence inflicted, is considerably greater than that which is required to destroy them, whereby satisfactory proofs of the crime are occasionally obtained. On the other hand, the body of a still-born child, dead from natural causes, is often covered with lividities and ecchymoses;—the fœtal blood does not coagulate with the same firmness as in the adult: hence the evidence derivable from the extent, situation and characters of the marks of violence, is generally of too vague and uncertain a kind, to allow of the expression of a medical opinion, that the child was certainly living when the violence was offered to it. The characters which have already been described as peculiar to wounds and contusions inflicted during life, (ante, p. 287,) may be met with in a child whether it have breathed or died without respiring. So again, these characters are open to the exceptions there pointed out; for they will be equally present, supposing the wounds to have been inflicted immediately after the cessation of respiration or circulation in the child, or after the cessation of the circulation only,—supposing the act of respiration not to have been performed. Marks of violence on the body of a child which had died in utero twenty-four or forty-eight hours before it was born, would not present the characters of injuries inflicted on the living. There would be no ecchymosis and no effused coagula of blood. These marks, when they exist, although they may establish that the child was either living or but recently dead at the time they were received, can never show that the child was born alive. Injuries met with on the bodies of children, alleged to have been born dead, ought however to be of such a nature as to be readily explicable on the supposition of their having arisen from accident. If they be such as to evince a wilful design to injure, from their nature, extent, or situation, it is a fair ground for a jury,—not for a medical witness, to inquire why these extensive wounds, or other marks of violence, were inflicted on a child, if, as it is alleged, it were really born dead. It must be confessed that in such a case, there would be a strong moral presumption of murder, although medical proof of life or actually live birth, might totally fail.

As a summary of these remarks, it may be observed, that although physiologically a child may live for a certain period after its birth with-

out respiring,—and legally its destruction during this period would amount to murder, yet there are at present no satisfactory medical data to enable a witness to express a positive opinion on this point. If other evidence were adduced of a child under these circumstances having lived and been destroyed; as where, for example, a woman causes herself to be delivered in a water bath, or an accomplice covers the mouth of an infant immediately after it is born, a medical witness would be justified in asserting, that the absence of the signs of respiration in the lungs was no proof that the child had been born dead. Indeed it is apparent, that the process could not be established from the criminal means actually employed to prevent it. Whether a jury would convict upon such evidence is doubtful: but this is of no importance to the witness:—his statements ought always to be made according to correct and well-ascertained principles, not for the purpose of procuring either the conviction or acquittal of parties accused of offences against the laws. In general, those cases in which questions relative to life before respiration, might arise, are stopped in the coroner's court,—the general practice being, where the signs of respiration are absent or imperfect, to pronounce that the child was born dead. If the lungs sank in water, the presence of marks of violence on the body would be considered as furnishing no evidence:—for the sinking of the lungs would be taken as positive evidence of still-birth, an inference upon which some remarks will be made in speaking of the hydrostatic test. In the mean time, the following case, which was the subject of a criminal charge at Havre in 1828, is in this respect interesting.

A woman was delivered of twins. So soon as the first child was born, but not before it had breathed, she killed it by fracturing its skull with a wooden shoe. In a few moments afterwards, the second child was born, but scarcely had its head presented, when she seized it and fractured its skull in the same manner. This double crime was soon discovered. On an examination of the bodies of both children, the same degree of violence was found, presenting in each case precisely similar characters. There could be no doubt, from the appearance of the injuries, that they must have been inflicted on both children at a time when the circulation was going on. In one child, however, it was proved that respiration had taken place, in the other that it had not. In the latter case many practitioners would at once have affirmed, that the child had not lived, because it had not respired, and would have proceeded to draw the inference that this could not have been a case of infanticide. Dr. Bellot, however, declared that, although the child had not breathed, he had no doubt that it had been born alive, and that it would have lived to respire, but for the violence inflicted. This opinion was chiefly founded upon the similarity in the characters presented by the marks of violence in the two cases. (Annales d'Hygiène, 1832, ii. 199.) See further remarks upon this subject by M. Ollivier, Ann. d'Hyg. 1843, i. 149; also by M. Devergie, op. cit. 1837, i. 400.

Evidence after respiration.—There is no doubt that the proof of the act of respiration, furnishes the best and strongest evidence of a child having lived at or about the time it was born. It does not, however, show that a child has been *born alive*. The physical changes in

the organs of a child, which result from the establishment of this process, take place in the lungs immediately, but in the heart and its appendages more slowly. It is, therefore, chiefly to the *lungs* that a medical witness looks for the proofs of respiration having taken place. Sometimes, however, these organs are found in their fœtal condition, or nearly so :—for although a child may have survived its birth for many hours, there may be no evidence of this from the state of the lungs. To such cases, the remarks now about to be made cannot, of course, apply :—the proofs of life must be sought for elsewhere, and if none can be found, the case is beyond the reach of medical evidence. But it is obvious that the occasional occurrence of cases of this description can present no objection to our constantly seeking for proofs of life in the lungs, any more than the fact of poison not being always discovered in a poisoned subject, is a bar to our seeking for the proofs of poison in every unknown case which presents itself. It is the more necessary to insist upon this point, because some have held, that as we cannot always derive proofs of life from an examination of the lungs of new-born children, we should abandon all evidence of this description, and leave the case in its original obscurity. The very object of medical jurisprudence is, to endeavour to remove these difficulties, and to show in every department of the science, the degree to which we may safely trust the medical proofs of crime, however inconsistent or contradictory they may at first sight appear.

Before proceeding to inspect the body, notes should be made of every appearance indicative of violence, either certain or suspected, in order that these may serve for after-consideration on the cause of death. It must be presumed also that the weight and length of the body have been determined for reasons already stated. We should also always notice, whether the umbilical cord be cut or lacerated, and at what distance from the abdomen of the child. These points, unless attended to before making an incision into the skin, will be lost as evidence. Some have pretended that the fact of respiration having been performed, would be indicated by the external configuration of the *chest*. Thus it is said, before respiration the chest is flattened, while after that process it is arched anteriorly. The diameters of the cavity have also been measured, and certain comparisons instituted, (Daniel,) but these experiments have been attended by no practical result, and have long been abandoned by medical jurists. Admitting that such a visible change of form is occasionally produced by respiration, it is obvious that in these cases, experiments on the lungs may be readily made ; and on the results of these, and not upon minute changes in the capacity of the chest, would a medical opinion be based.

The cavity of the chest may be conveniently laid open by carrying incisions from below the clavicles downwards on each side from about half the length of the ribs backwards. The diaphragm may be separated from the cartilages without opening the abdomen ; the ribs sawn or cut through, and the flap formed by the anterior parietes of the chest, turned upwards. If the child have *not respired*, the following

appearances will be seen. The thymus gland, as large as the heart, occupies the upper and middle portion of the cavity ;—the heart in its pericardium is situated in the lower and middle portion, and is rather inclined to the left side. The lungs are placed quite in the back part of the chest, so as often to give the impression that they are wanting. In some instances, they project slightly forwards by their anterior margins, but in no instance, unless congested, infiltrated or otherwise diseased, do they cover and conceal the pericardium. The thymus gland is sometimes of a pale fawn—at others of a deep livid colour : but there is no perceptible difference in this organ in new-born children, before or after the performance of respiration. On the other hand, when the child has *fully respired*, the appearances will be as follows. The most striking differences will be in the colour and prominence of the lungs. They are of a light red hue, project forwards—appear to fill the cavity of the chest, and cover and in great part conceal by their anterior margins, the bag of the pericardium. We may meet with every variety in the appearances between these two extremes ; for the process of respiration often requires a considerable time in order that it should be *fully* established, especially in those children which are of weakly constitution or prematurely born. Hence the lungs will be found to occupy their respective cavities to a greater or less extent, and to cover the pericardium more or less, not according to the length of time which a child has lived, but according to the perfection with which the process of respiration has been performed. It will be seen hereafter, that although as a general rule the lungs become more perfectly filled with air in proportion to the time which a child survives its birth, yet this is open to numerous exceptions. It will next be necessary to give particular attention to certain other physical characters presented by the lungs.

1. Colour.—The colour of the lungs before respiration is of a blueish red, or deep violet, but it is subject to slight variation. Some medical jurists have compared it to that of the spleen. It is important to remark, that a very short exposure to air will materially alter the colour, so that it should be observed and recorded immediately on opening the chest. After respiration, the lungs acquire a light red hue, in proportion to the degree in which the process has been performed. If imperfectly established, they will be mottled, generally about the anterior surfaces and margins, the patches of light red being intermixed with the livid fœtal hue, and being slightly raised, as if by distension, above the general surface of the organs. The light red tint changes, after a short exposure to air, to a bright scarlet. This change in the colour of the lungs is not a necessary, nor is it an invariable consequence of a child having lived after its birth. I have known a child to live twenty-four hours respiring feebly, and on examining the body, the colour of the lungs was identical with that of the organs in the fœtal state. The change of colour is then a usual, but by no means a necessary consequence of the enjoyment of life :—so that its absence does not furnish positive evidence of still-birth. Again, the circum-

stance of the lungs having a light red colour, is not an infallible criterion of the child having lived and breathed, for the artificial introduction of air by a tracheal tube, or otherwise, in the attempt to resuscitate a still-born child, is attended with the same physical change. In the course of numerous experiments, purposely made, I have found no appreciable difference. Bernt says, that artificial inflation cannot produce a scarlet red tint in the organs, and therefore that this is a criterion of respiration. (Ed. Med. and Surg. Jour. xxvi. 367.) I have not only observed this tint to be absent in respiration, but have actually produced it by artificial inflation in a dead child.

2. Volume.—The difference in the relative situation of the lungs before and after respiration, has been already described. This difference depends entirely upon the increased volume or dilatation of the organs arising from the introduction of air. Before respiration, the lungs are in general scarcely visible, unless forcibly drawn forwards in the chest. When respiration has been perfectly accomplished, the volume is so much increased, that the bag of the pericardium is almost concealed by them. Respiration must, however, have been very perfectly performed in order that this condition should exist to the full extent described; but I have known the lungs to acquire a considerable volume in a healthy and vigorous child from only two or three respirations. The child was destroyed by craniotomy, and died before it was entirely delivered. In other instances, a child may live for one or two days, and the volume of the organs be but little altered. Schmitt has remarked, that the lungs have sometimes a considerable volume before respiration—I have met with this in more than one instance; but this condition will probably be found in general to depend on disease. It must not be forgotten that the altered volume of the healthy lungs depends on the introduction of air:—hence the effect is the same, whether the air be derived from respiration,—from artificial inflation, or generated by putrefaction. Other circumstances must therefore be considered, before we draw any inference from this physical charge.

3. Consistency.—The lungs, before respiration, feel like the liver, or any of the other soft organs of the body. They are firm under the finger, but their substance may be lacerated by violent compression. After respiration has been fully performed, there is a distinct sensation of what is termed crepitus on compressing them, i. e. air is felt within them. This condition of the organs must, of course, depend on the degree to which respiration has gone on. The lungs of children that have lived for a considerable time after birth, will sometimes give no feeling of crepitation under the finger. Generally speaking, lungs of this kind present the other fœtal characters:—thus they are small and of a livid colour. There are, however, cases in which the organs may have the light red colour of respiration, and be actually much dilated in appearance, yet no feeling of crepitus will be perceptible on pressure. This character, therefore, is by no means a necessary accompaniment of the other two. Crepitation furnishes presumptive evidence of respiration; but it may be equally met with in lungs that

are putrefied, or which have received air by artificial inflation. The characters here described are seldom found in the lungs of children that have been born prematurely, although they may have lived for some time after birth. They depend on respiration; and in the exceptional cases referred to, this process is only very slowly established.

4. ABSOLUTE WEIGHT. *The static test.*—It is generally admitted by medical jurists, that the weight of the lungs before respiration, is less than that which they have after the establishment of the process. From this an inference has been drawn, that the absolute weight of the lungs in an unknown case, compared with certain averages, will enable us to ascertain whether respiration has or has not been performed. In order to determine the weight of the lungs, these organs should be carefully separated by dissection from the heart and thymus gland, and removed with the trachea and bronchi attached. Previously to their removal, ligatures should be placed on the pulmonary vessels, so that no blood may escape from the lungs. They should now be weighed, and the weight accurately noted in grains. In taking this weight, it does not appear necessary to make any distinction founded on the sex of the child, or the difference of weight in the two lungs; the only exception would be, perhaps, in relation to twin children imperfectly developed. The average weight *before respiration*, derived from nine cases, was found to be 649 grains. According to Dr. Traill, the weight varies from 430 to 600 grains. It is of importance, in taking the weight of these organs, to be certain that the child is at or near maturity; owing to a neglect of this rule, it is highly probable that comparisons have been made of the absolute weight of the lungs in different children, which a full statement of the facts would not have justified. The average weight of the lungs *after respiration*, derived from three cases was 927 grains; but in making an estimate of this kind, much will depend upon the degree to which respiration has been carried. In three cases, where the children lived half an hour, six hours, and twenty-four hours respectively, the process had been so imperfectly performed, that the lungs varied but little in weight from the average before respiration. (G. H. Rep. No. V.) The truth is, we cannot compare the lungs of children, as to weight, according to the time which they may have survived birth, but rather according to the degree to which the lungs have been penetrated by air. In one instance of alleged infanticide, where the child was probably killed soon after birth, the lungs weighed 1000 grains. In another instance, where the child had certainly lived eight or nine days, the lungs weighed only 861 grains. In the first case, respiration had been perfectly performed; in the second, imperfectly. Therefore, to say that the lungs weigh so much *after* respiration amounts to nothing, unless we can estimate by a sight of the organs, its degree; and any calculations founded upon such dissimilar cases, must unavoidably lead to error. This increase of weight after birth is commonly ascribed to the altered course of the blood under the establishment of

the respiratory process; and to the fact, that more blood circulates through the lungs after, than before respiration. Practically, this view is confirmed by the contraction of the ductus arteriosus, and the simultaneous enlargement of the two pulmonary arteries; changes which have been occasionally observed where the child has survived its birth for only a very short period. As these changes in the duct depend on the establishment of respiration, so we cannot expect to find them when the process has been imperfectly performed, although the child may have lived several days.

It appears to me that the general opinion on this subject is correct, namely, that the healthy lungs of mature new-born children become heavier after respiration, and according to its degree; and where a deviation from this rule is observed, it may probably be explained by the circumstance that the lungs of an immature have been compared with those of a mature child, the lungs of an undeveloped twin with those of one not a twin, or the lungs of one which had breathed imperfectly, with those of another in which respiration had become well established. In this respect the extensive tables drawn up by Lecieux appear to me to be faulty, and to lead to erroneous inferences, relative to the effect of respiration on the absolute weight of the lungs. The weights of the organs are noted, but the *degree* to which respiration had been performed is so loosely stated, as to allow of no fair inference of the effect of that process upon the weight. The time which the children survived is stated; but this, as it is very well known, furnishes no criterion of the degree to which respiration has been carried. Again, we are not informed whether due care was taken to ascertain if the lungs were healthy or diseased. (Considérations sur l'Infanticide, Paris, 1819.) The following table of the weight of the lungs, in four cases, will show how much the organs are liable to vary in weight after birth according to the *degree* of respiration.

Case 1.	Case 2.	Case 3.	Case 4.
Born dead.	Lived six hours.	Lived twenty-four hours.	Lived nine days.
Weight, 687 grs.	774 grs.	675 grs.	861 grs.

Relying upon a table of this kind only, without comparing the other characters of the lungs with the weight, it might be inferred that the organs would weigh less in a child which had survived its birth twenty-four hours, than in another which had been born dead; and that there would be very little difference in the weight, whether the child lived six hours or nine days; but when it is stated, that in case 3 the lungs had every fœtal character possessed by those in case 1, and that in case 4, respiration had been obviously very imperfectly performed,—the difficulty is removed. Such cases should rather be compared with the lungs in the fœtal than in the respired state. They merely show what is very well known to and admitted by all medical jurists, that there are some instances in which the fact of respiration cannot be determined by the application of the static, or any other test to the lungs. But this is certainly no valid reason why evidence

from this source is to be rejected in all other cases. It may be fairly granted that the weight of the lungs of some children who have outlived delivery, may not come up to the weight assigned to those of children that have breathed; because, as we have seen, children may survive birth many hours without the process being properly established. On the other hand, as in Chaussier's observations, the lungs of the still-born may be sometimes as heavy as those of children that have respired; but since such lungs would contain no traces of air, the weight above the average in these cases could not be assigned to respiration. Among such subjects, whatever might be the weight of the lungs, if the facts were unknown, it would be impossible to say whether they were born living or dead. (See Ed. M. & S. J. xxvi. 375.) We must, therefore, not fall into the error of supposing that the lungs increase in weight according to the length of time which a child survives its birth: it is within the limits of a few days, according to the degree of perfection with which a child respires; hence we may meet with cases of children being born alive, surviving some hours or days, and yet after death the lungs will retain the fœtal weight. This is the case in immature subjects, in most twin children and in those which are mature but weakly. Among many instances that have come to my knowledge, no difficulty of this sort, however, has occurred. The signs of respiration have been sufficiently well developed to justify a medical opinion, although the child had probably not survived its birth above a few hours, or even minutes. (G. H. Rep. April, 1842.) The cases of imperfect respiration, above alluded to, rarely go beyond a coroner's inquest for want of clear evidence of life. There may be a difference of opinion as to the relative number of instances of perfect and imperfect respiration in new-born children; but the case is never likely to proceed to trial, unless the signs of this process are well-marked; and thus many charged with murder must escape, through the want of sufficient medical evidence to establish the fact of respiration and life.

It is scarcely necessary to observe, that the air which the lungs receive by respiration, cannot add to their absolute weight. This is because they are in the condition of a bladder which weighs the same, whether it be filled with air or empty. The increase of weight is solely due to the additional quantity of blood, which permeates their structure by the altered course of the circulation. Hence it follows that where the lungs are distended with air, either from artificial inflation, or from putrefaction, the fœtal weight will remain unaltered, and by this means it is contended, we may distinguish lungs that have respired from those which have been artificially inflated. Orfila states, that the fœtal lungs weigh more before they are artificially inflated, than afterwards,—a circumstance which may depend upon the fact that the impulse employed in inflation, may have forced out a portion of blood or other liquid. In carefully performing this experiment, I have found that there was not even the least fractional difference; but that the inflated lungs weighed precisely the same as in the

uninflated state. From what has already been said, it follows, that great weight of the lungs can obviously furnish no proof of respiration, unless this be accompanied by the other physical changes indicative of that process,—as, for example, great increase in volume from the presence of air, and crepitation. If the lungs be very heavy, and at the same time contain no air, it is certain that the increase of weight depends upon disease or other causes,—not upon respiration. I have lately had to examine a case in which the lungs were large and weighed upwards of 1200 grains. They contained no air; for when divided into thirty pieces not one portion floated, nor could any air be seen on the closest examination. It was therefore clearly impossible to ascribe the weight so much above the average, to respiration. It must not be forgotten that all the physical characters presented by lungs that have respired, are liable to certain fallacies; but, as in the evidence derived from tests used in poisoning, these may be removed by not basing an opinion on one or two conditions only. We must take the whole combined; for it would be as wrong to regard great weight in the lungs *taken alone* as an absolute proof of respiration, as it would be to draw the same inference from a mere change in the colour, volume, or consistency of the organs.

5. Test of Ploucquet.—This so-called test for determining whether or not the act of respiration has taken place, was proposed many years since by M. Ploucquet. It is founded on a comparison of the absolute weight of the lungs with the weight of the body of the child. Admitting that the lungs increased in weight from the establishment of the respiratory process, it was supposed that a like difference would take place in the relative weight of these organs to the body; and that the ratios thus procured, compared with certain averages, would enable a medical jurist to determine in an unknown case, whether or not a child had respired.

Ploucquet conceived that the average ratio of the weight of the lungs to the body in children which had not breathed, was 1 : 70; and for those which had breathed, 2: 70 or 1 : 35. Subsequent researches, however, made by Chaussier and others, have shown that these numbers cannot be considered to represent the true averages. The most serious objection to the employment of this test, in cases of infanticide, is, that the lungs and the body are liable to vary in their relative weights, in children of the same age; and, à fortiori, this variation must exist to a greater extent among children which have reached different ages. There may be various degrees of development in the body of a child, without any necessity existing for a corresponding development taking place in the lungs. It is unnecessary to enter into speculations relative to the causes: experience has shown that such variations really exist; and all that a medical jurist has to consider, is, whether the differences can be reduced within limits which may make the test available in practice. M. Devergie states, from his experiments, that Ploucquet's test affords no satisfactory results, as applied to the bodies of children which have not reached the eighth month of gestation. According to

him, the ratio is for the eighth month :—Before respiration, 1 : 63. After respiration,—1 ; 37. Ninth month :—Before respiration, 1 : 60. After respiration, 1 : 45. The ratio, he observes, becomes higher after respiration, in proportion to the perfection with which the process has been carried on.—(Médecine Légale, i. 556. See also Ann. D'Hyg. 1835, 485. Med. Gaz. Nov. 1842, p. 208.) The facts which have been collected by different observers, appear to me to show that Ploucquet's test is not fitted to determine, in an unknown case, whether a child has breathed or not.

6. Blood in the pulmonary vessels.—It has been asserted that if blood be found in the pulmonary vessels of a child, we are justified in assuming that respiration has taken place. On the other hand, the absence of blood from these vessels has been considered to prove that a child has not respired. This assertion must have originated in a want of correct observation. The pulmonary vessels contain blood, both in the child which has, and in that which has not respired. It is possible that the vessels may contain more after respiration, than before ; but in most cases of infanticide, it would be difficult to found any distinction on a point of this nature. In examining the bodies of children which have died without respiring, and those of others which have lived and respired for some time after birth, no perceptible difference was found in the quantity of blood existing in these vessels in the two cases. The fact is, the excess of blood after respiration becomes distributed through the minute capillary system of the lungs : it does not remain in the larger trunks. The state of the pulmonary vessels, therefore, furnishes no evidence of respiration or the contrary. The same observation will apply to the presence of blood in the substance of the lungs. It is said that on cutting through lungs that have breathed, the incisions are followed by a copious flow of blood ; but this, it is alleged, does not happen with lungs that have not breathed. In performing this experiment on several occasions, I have been able to perceive no well-marked difference. The blood in the new-born child may be found coagulated or not, and there is no difference in this condition, whether it be born living or dead.

7. The specific gravity of the lungs.—The specific gravity of the lungs is greater before, than after respiration ; for although the organs become absolutely heavier by the establishment of the process, this is owing not to the air, but to the additional quantity of blood received into them. The air thus received, so increases the volume of the organs, as to more than counteract the additional weight derived from the blood, and thus apparently to diminish their specific gravity. Under these circumstances the organs readily float on water. From several experiments, I have found that the specific gravity of the lungs before respiration, i. e. in the fœtal condition, varies from 1.04 to 1.05. They are about one-twentieth part heavier than their bulk of water. After respiration, the specific gravity of the lungs with the air contained in them, I found in one experiment to be 0.94, i. e. the organs were about one-seventeenth part lighter than their bulk of water.

Thus it is that a very small quantity of air will render these organs buoyant in water; and an alteration in the volume of the lungs required for this purpose, would not be perceptible to the eye. It will be understood that the specific gravity of the substance of the lungs is unchanged; they are rendered only apparently lighter by the air contained in their cells on the same principle as a distended bladder. Hence it follows, that the same apparent diminution of specific gravity, will take place whether the air be derived from respiration, artificial inflation or putrefaction. It is on this property of the lungs that the application of what is termed the *hydrostatic test*, or the docimasia pulmonaris, is founded,—a subject which may be more appropriately considered in another chapter.

CHAPTER XL.

THE PROOFS OF A CHILD HAVING LIVED AT ITS BIRTH. THE HYDROSTATIC TEST. DOCIMASIA PULMONARIS.

The hydrostatic test has been long known, and various opinions have been entertained relative to its efficiency and value. Many of the objections that have been urged to its use, appear to have arisen from a mistaken view of the evidence which it is capable of furnishing. It is assumed, that when properly applied and with a full knowledge of the exceptions to which it is exposed, it may afford in many cases good evidence, whether a child has or has not respired. The mode of performing the experiment is extremely simple. Having removed the lungs from the chest, they should be placed, still connected by the trachea and bronchi, upon the surface of distilled or river water. If they sink, it should be noted whether the sinking take place rapidly or slowly. If they both sink, the two lungs should be tried separately; for it is sometimes found, that one, commonly the right, will float while the other will sink. Supposing that both lungs sink, it will then be proper to divide each into twelve or fifteen pieces, and place these pieces separately on water. If, after this, they all sink, the inference is, that although the child may have lived and survived its birth, there is no evidence of its having respired.

On the other hand, the organs when placed on water may float,—it should then be noticed whether they float high above the surface, at or below the level of the water; sometimes they will indifferently float or sink. These differences will lead to a conclusion respecting the degree to which respiration has taken place. It will now be proper to sepa-

rate the lungs, and determine whether the buoyancy be due to one or both. Each lung should then be divided as before, and each piece separately tried. If all the pieces float, even after firm compression, we have good evidence, cæteris paribus, that respiration has been very perfectly performed. Should any of the divided portions sink in water either before or after compression, our opinion may be accordingly modified. Some have recommended that the lungs should be placed on water with the heart and thymus gland attached; but there appears to be no good reason for this, since it is as easy to form an opinion of the degree of buoyancy possessed by the lungs from the readiness with which they float, as by observing whether or not they have the power of supporting these two organs.

Such, then, is the method of employing the hydrostatic test in cases of infanticide. With regard to its use in medical jurisprudence, it should be observed that the floating of the lungs in water is not, as it is often incorrectly represented to be, a proof that the child has been *born alive:* nor is the fact of their sinking in water, any proof that the child was *born dead.* The floating under the limitations to be now described, proves only that a child has *breathed;* the sinking, either that it has *not breathed* or breathed but imperfectly. The fact of a child having been *born* living or dead, has no relation whatever to the employment of the hydrostatic test under any circumstances. There are indeed cases of infanticide which may be readily established without resorting to this test: all that the law requires is proof of a child having been born living,—whether this proof be furnished by the state of the lungs through the hydrostatic test, or in any other way, is of no moment. The signs of life are commonly sought for in the lungs, because it is in these organs that the changes produced by a new state of existence, are first perceived; but this examination may be dispensed with, when the woman confesses that the child was born alive—when others have seen it manifest life by motion or otherwise after its birth, or lastly, in cases, where, without being seen, it has been heard to cry. The crying of a child has been admitted as evidence of live birth on several trials for infanticide; although from what will be hereafter said, it is possible that a child may be heard to cry and die before its body is entirely born.

Objections to the hydrostatic test.—1. Sinking of the lungs. It is said that the test cannot always show whether a child has or has not survived its birth; because the lungs of children that have lived for many years, have been observed to sink entirely in water. In some instances this may depend on disease, tending to consolidate the air-cells, as hepatization or scirrhus; in others. on œdema or congestion; but this cause can create no difficulty, since the reason for their sinking in water, would be at once obvious. The hepatized portion of lung may be known by the firmness with which it resists cutting with a knife, as also by the fact, that it is impossible to distend it artificially with air. On the other hand, there are cases in which the lungs appear healthy and unaffected; all that we can perceive is, that they re-

tain their fœtal condition. This is a very different state to that of hepatization, because the lungs may, in this case, be made to receive air by artificial inflation. It is remarkable that life should continue for many hours, and sometimes for days under such a condition; but the occasional existence of this state of the organs in a living child, is placed beyond all dispute; the explanation of the causes upon which it depends—how it is that a child may live and breathe for hours or days, and that no signs of respiration be discovered in its body after death is involved in great difficulty. The late researches of Dr. E. Jörg, of Leipzig, have, however, thrown some light upon the subject; and these may probably lead the way to other discoveries in this obscure department of physiology. Some of Dr. Jörg's views are peculiar. He considers that the act of parturition, as well as the duration of the process, has a material influence upon the system of a child; and that they serve to prepare it for the efforts which it has to make in performing respiration. (Die Fötuslunge, Grimma, 1835.) Supposing the first inspirations made by a child to be, from any cause, feeble or imperfect, then the organs will become only partially distended; the remaining portions will preserve their fœtal condition. Dr. Jörg considers this as a positively diseased state of the lungs in the new-born child, and he has given to it the name of "atelectasis; (ἀτελὴς "incomplete"; ἔκτασις "expansion." It may proceed from various causes. He considers, that children which are born after a very easy and rapid delivery are liable to it; and thus it may be found in a mature, as well as in an immature child. Any cause which much weakens the vital powers of a child before its actual birth, may give rise to the occurrence of this imperfect dilatation of the lungs. In this way, it may be due to long-continued pressure on the head during delivery, or to hæmorrhage from the cord. All the causes of asphyxia in a new-born child, will, when operating even in a very slight degree, also produce this atelectasic condition. When only a part of the lungs becomes, in the first instance, distended, the child may not afterwards acquire sufficient strength to fill the remaining portions; it may thus live on for some hours or days, respiring at intervals, and becoming occasionally convulsed, in which state it will probably sink exhausted and die. Jörg has remarked, that those portions of the lung which are not speedily distended by air, afterwards become consolidated or hepatized, so that all traces of their vesicular structure are lost. The length of time which the child survives, will depend upon the degree to which its lungs have become dilated.

It is not necessary that the whole of the lungs should have received air, in order that a child should continue to live even for some months after its birth. A few years ago, I met with the following case, which will serve to illustrate this statement. A child, aged six months, had, it was supposed, been destroyed by suffocation. Upon opening the thorax, the viscera were found healthy; but the whole of the inferior lobe of the right lung was, so far as regarded colour, density and structure, precisely like the lungs of the fœtus: no air having ever pene-

trated into it. It had become developed in size, but its vesicular structure was perfectly destroyed. When the whole of the lung was placed in water, it floated; but when the inferior lobe was separated, it immediately sank to the bottom of the vessel. I have no doubt that this was a case of atelectasis, such as it is described by Jörg. The lobe had not received air in the first instance; and had become afterwards consolidated or hepatized, so that it could not be inflated. Dr. Albert met with a case, where a child died thirty-six hours after its birth, having been attacked by convulsions at intervals during that time. On inspection, the whole of the right and the lower lobe of the left lung, were found to be in their fœtal condition, and they immediately sank when immersed in water. There was no diseased appearance in the organs, and the undistended portions were easily filled by blowing air into them. (Henke's Zeitschrift. 1837, ii. 422.) It is quite necessary for a medical jurist to be aware, that this state of the lungs which is here called *atelectasis*, is by no means unfrequent among newborn children, although attention has only been of late years drawn to the subject. When no portion of air is found in the lungs of a child, there is no test by which such a case can be distinguished from one where the child has come into the world dead. These cases of atelectasis are ordinarily set down as exceptions to a very general rule; but I cannot help thinking, that they are more common than some medical jurists are inclined to admit. In examining the body of a child, the history of which is unknown, it is therefore proper, that the possible occurrence of these cases should be well borne in mind. It appears to me not improbable, that many such come yearly before coroners in this country; and that they are dismissed as cases of still-born children, notwithstanding that marks of violence are often found upon the bodies. If, as it has been already observed, the lungs sink in water, the fact is commonly regarded as sufficient evidence of still-birth. This is assuredly putting the most humane interpretation on the circumstances; and so far the result is not to be objected to; but we should take care, in carrying out this principle, that we do not throw obstacles in the way of judicial inquiry, and lead to the concealment of crime. Professor Bernt met with an instance, in which a seven-months child died two hours after birth; and when its lungs were divided and placed on water, every fragment sank. Remer has reported another, in which the lungs sank in water, both entire, as well as when divided, although the child had survived its birth at least four days. (Henke. Lehrbuch der G. M. p. 374.) In this case, the navel-string separated naturally before death. Orfila found, in a child which had lived eleven hours, every portion of the lungs, when divided, to sink on immersion. In three other cases, in which the subjects survived birth, four, six, and ten hours, the lungs also sank when divided; two of these were mature children. (Med. Leg. i. 375.) Other instances are recorded by Daniel, Schenk and Osiander. Metzger supposed that premature children alone were likely to present this anomaly; i. e., of continuing to live after birth without

leaving any clear signs of respiration in their lungs. Perhaps the greater number of these cases have occurred among premature children; but recent observations satisfactorily prove, that perfectly mature children may also be the subjects of this singular condition.

I may add to these instances, two which have occurred under my own observation. In one, the case of a mature male child, the lungs sank in water, although the child had survived its birth for a period of six hours. In the other, the case of a female twin, the child survived *twenty-four hours;* and after death the lungs were divided into thirty pieces; but not a single piece floated, showing, therefore, that although life had been thus protracted, not one-thirtieth part of the structure of the lungs, had received sufficient air from respiration to render it buoyant. (Guy's Hospital Reports, No. v. p. 355.) In the latter instance no particular remark was made during life respecting the respiration of the child. These cases show most clearly that buoyancy of the lungs is not a necessary consequence of a child having lived and breathed for some time after birth. Probably, had this been a case calling for medico-legal inquiry, the lungs would have been cut to pieces; the sinking of the divided pieces in water, either before or after compression, would have been set down as negativing the act of respiration, and, unless other strong evidence were forthcoming, the fact of the child having survived its birth. Here, again, we perceive the necessity of not hastily assuming that a child has been born dead, because its lungs sink in water. There may be no good medical evidence of such a child having lived after birth; but assuredly the mere sinking does not warrant the common dictum, that the child was necessarily dead when born; it would be as reasonable to pronounce, in a question of poisoning, that the fact of an individual having died from poison, was negatived by the non-discovery of a poisonous substance in the stomach of the deceased.

It must be apparent, on reflection, that cases of this description are beyond the reach of the hydrostatic, as well as of all other tests applied to the respiratory organs, because the lungs do not receive and retain a perceptible quantity of air, although the subjects may have lived some hours. The hydrostatic test is no more capable of showing that such subjects as these have lived, than it is of indicating from what cause they have died. Facts of this kind, demonstrate that existence may be for some time continued under a state of the respiratory process, not to be discovered after death. In the opinion of some, these cases form a serious objection to the hydrostatic test; but it is difficult to understand how they can affect the general application of it; or why, because signs of respiration do not always exist in the lungs of children which have lived, we are not to rely upon them when they are actually found. Poison is not always discoverable after death in the stomach of a person who has taken it; but this does not prevent a medical jurist from searching for it, and relying upon its discovery, under proper precautions, as evidence of poisoning in any other case.

These singular instances prove that we are greatly in want of some

sign to indicate life after birth, *when the marks of respiration are absent.* Until we discover this, we must, of course, make the best use of that knowledge which lies at our disposal; taking care to apply it to those cases alone to which experience shows it to be adapted. In the mean time, the common inference that a child has been born dead because its lungs sink in water, is never likely to implicate an innocent party; it can only operate by sometimes leading to the liberation of the guilty. From the cases already reported, it is a fair subject of consideration, whether a great error is not committed by those medical practitioners who pronounce all children to have been born dead, merely because the lungs contain no air, and readily sink when placed on water. This, it is true, is the common opinion, but it is not warranted by observation. We are only entitled to say, in all such cases, that there is *no evidence* of a child having breathed or lived. Many might be disposed to consider it an unnecessary degree of refinement, to hesitate to express an opinion that a child was born dead when its lungs sank entirely in water, because certain cases have occurred wherein these characters have been possessed by lungs taken from the bodies of children that have survived their birth many hours. To those inclined to adopt this view, I would say, the answer to such a question is of far greater importance in a medico-legal, than in a medical light. In the latter case, no responsibility can be attached to the expression of the opinion commonly adopted; in the former case, however, when the question refers to child murder, a serious responsibility attaches to a practitioner; and he can only guard himself from unpleasant consequences, by basing his evidence on carefully observed facts.

If a child can live for six or twenty-four hours, without its lungs receiving sufficient air to allow even one-thirtieth part of their substance to float, it is clear that such a child may be the subject of a murderous assault. If a medical practitioner, losing sight of this fact, proceeds to declare, from the lungs sinking in water, that the child must have been born dead, his assertion may afterwards be contradicted, either by circumstances, by the testimony of eye-witnesses, or by the confession of the woman herself. He will be, perhaps, required to revise his opinion; and he will then find, that the fact of the lungs sinking in water is rather a want of evidence of life after birth, than a positive proof of a child having been born dead. It cannot be denied, that the sinking of the lungs is a presumption in favour of still-birth, but it is nothing more;—it is not, as it is often set down, an affirmative proof of the child having been born dead. There are many cases reported which show that this is not an unnecessary caution. Meckel relates two instances where the lungs sank in water, but the women respectively confessed that they had destroyed their children; according to the general rule, these children must have been born dead, and no murder could have been committed! (Gerichtl. Med. 365.) For other examples of a similar kind, I must refer to the following works: Ann. d Hyg. 1837, i. 437; also, 1841, 429; Henke's

Zeitschrift, 1840, xxvii. Erg. h.; Brit. and For. Med. Rev. Jan. 1842, p. 250. The cases there reported appear to me to convey a serious warning to medical witnesses.

It is a matter of surprise, that in the later editions of his work, Dr. Beck should have asserted, that "it is both safe and just to consider as dead, every child that has not breathed; i. e., whose lungs sink in water. (Med. Jur. 284.) He at the same time admits that children may come into the world living without breathing; and the law holds under the decisions of its expounders, (see antè, p. 438,) that respiration is only one, and not the exclusive proof of life. In order to establish life or even live birth, respiration need not always be proved, either in civil or criminal cases. (Fish v. Palmer, 1806. See post, BIRTH.) A medical jurist would therefore be no more justified in asserting that all such children were necessarily born dead, than that they were born living: and in stating what is the plain and obvious truth, it is not possible that he can ever be the means of involving an innocent person. It is certain, however, in departing from the truth, and stating what is contrary to well-known facts, that when the lungs of a child sink in water, it is safe and just to consider such child as having been born dead, he is incurring the risk of exculpating a really guilty person; for it cannot be too strongly borne in mind, that a woman is not charged with murder, merely because the lungs of a child float or sink in water; but because there are upon its body, marks of violent injuries apparently sufficient to account for the death of a newborn child, or very strong moral presumptions of her guilt. (See Ann. D'Hyg. 1836, ii. 362.)

II. BUOYANCY OF THE LUNGS FROM OTHER CAUSES.—It is said that the lungs may receive air and acquire buoyancy from other causes than respiration. Of this fact there can be no doubt. These causes are two: *putrefaction* and *artificial inflation*. It was supposed, that the lungs of a still-born child might become emphysematous from a compression of the sides of the thorax during delivery; but it is difficult to understand, how in this way air should be extricated from these organs any more than it would from the liver under similar circumstances. The truth probably is, that what has been described as emphysema of the lungs in still-born children, was nothing more than partial or imperfect respiration, performed during delivery. In examining the bodies of many still-born children, I have never met with any appearance resembling what has been described as a state of emphysema, independently of respiration and putrefaction.

1. *Putrefaction.*—The lungs of a still-born child, when allowed to remain in the thorax, are slow in undergoing putrefaction; but nevertheless, they may sooner or later acquire sufficient air to render them buoyant in water. This form of gaseous putrefaction, may even take place in the lungs of a child which has died in utero. One instance of this kind is recorded by Dr. Albert. (See Henke's Zeitschrift, 1837. ii. 379.) In this case the child was cut out of the uterus in a putrefied state, and its lungs floated when placed on water It has

been supposed that the formation of air may take place in the lungs from putrefaction without this being indicated by change in colour, smell or other properties of the organs, but this is doubtful.

When the lungs are putrefied, this will, in general, be indicated by putrefaction having extended throughout all the soft parts of the body. The organs, according to the degree of *putrefaction*, will be soft, pultaceous, of a dark green or brown colour, and of a highly offensive odour; the serous membrane investing the surface, will be raised in large visible bladders, from which the air may be forced out by very moderate compression. It has been remarked, that under the same conditions, gaseous putrefaction takes place as rapidly in the liver, heart and thymus gland of a new-born child, as in the lungs. We should, therefore, examine the general condition of the body; the distension of the lungs with gas from putrefaction, cannot be easily overlooked nor mistaken for the air of respiration. The answer to any objection founded on the putrefied state of these organs, must at once suggest itself. It is impossible that any well-informed medical witness can expect to obtain satisfactory evidence from experiments on the lungs of such subjects. He should at once abandon the case, and declare that in regard to the question of respiration, medical evidence cannot establish either the affirmative or the negative. The fact of his not being able to give the evidence required, cannot be imputed as a matter of blame to him; because this is due to circumstances over which he has no control. In a case of poisoning, the post-mortem appearances in the viscera may be entirely destroyed by putrefaction; but no practitioner would think of looking for proofs where the circumstances rendered it utterly impossible for him to obtain them.

A case may possibly occur, wherein the characters presented by the lungs will be such as to create some doubt whether the buoyancy of the organs be due to putrefaction or respiration, or what is not unusual, whether the putrefied lungs may not also have undergone the changes of respiration. The facts may be explicable on either assumption. In such a case, it has been recommended that the witness should lean to the side of the prisoner,—in other words, he should give an opinion, that the child suspected to have been murdered, had not respired. This advice is equal to recommending a witness to take upon himself the duty of a jury, and virtually to acquit a prisoner upon a doubt existing in his own mind, in respect to only *one* portion of the evidence adduced against her. The ill effects of following this kind of advice are well seen in a case reported in Henke's Zeitschrift, (1843, i. 102, Edg. h.) where an opinion was improperly given by a medical witness, that the child, the whole of the organs of whose body were in an advanced state of putrefaction, was born dead; and the prisoner afterwards confessed that it had been born living! This shows that it is always better to leave a doubtful case as we find it, than to express a positive opinion on one side or the other, which can never amount to more than a conjecture. If a witness were simply to assure the jury, that medical evidence could not solve the question

whether the child had lived,—if he were to assert what is really the fact, that his experiments would not allow him to say, whether the child had or had not respired,—it is certain that no innocent person would ever be convicted, or a guilty person acquitted upon his evidence. It is for a jury only to judge of guilt from *all* the circumstances laid before them; but it is assuredly not for a medical witness to prevent all further investigation and put an end to the case, by leaning to the side of the accused, when there is really a doubt upon his mind. It is his duty to state that doubt, and leave the decision of guilt or innocence in the hands of the Court.

2. *Artificial inflation.*—It has been alleged that the lungs of a still-born child, may be made to assume, by artificial inflation, all the characters assigned to those, which have undergone respiration. Thus, it is said, a child may not have breathed, and yet the application of the hydrostatic test would lead to the inference that it had. It will be seen that the force of this objection, goes to attack directly the inference, derived from the presence of air in the lungs. The objection can, it appears to me, be admitted only under one form, namely, as it applies to lungs which have been inflated while lying in the cavity of the chest. Any experiments performed on inflation after their removal from this cavity, can have no practical bearing; since in a case of infanticide, we have to consider only the degree to which the lungs may be inflated by a person who is endeavouring to resuscitate a still-born child. The difficulty of inflating the lungs of a new-born child, is too well known to require to be here adverted to; the greater the violence used, the less likely is the air to pass into these organs; but it rather finds its way through the œsophagus into the bowels. Dr. Albert, a late writer on the subject, denies that the organs while lying in the chest can be so filled with air, either by the mouth or by means of a tube, as to be rendered buoyant in water. In performing this experiment several times, he never found a trace of air in the air-cells, and he contends that medical jurists have begun at the wrong end (den Gaul vou hinten aufgezaümt,) in endeavouring to seek for answers to an objection, before they had ascertained that such an objection could have practically any valid existence. (Henke, Zeitschrift, 1837, ii. 390.) Having had several opportunities of examining the lungs of children in which inflation had been resorted to, not for the express purpose of creating an objection to the hydrostatic test, but with the *boná fide* intention of resuscitating them, I may here state the results. In some of these instances a tube had been used, and in others the mouth. In the first case it was found on inspection, that only about one-thirteenth part of the structure of the lungs had received air. In the second, no part of the lungs had received a trace of air, although inflation had been repeatedly resorted to; the air had passed entirely into the abdomen. In a third, attempts were made for upwards of half an hour to inflate the organs; but on examination, not a particle of air was found to have penetrated into them. In a fourth, no air had entered the lungs, and in a fifth, although a small portion had penetrated into the

organs, it was readily forced out by compression. In repeatedly performing experiments on dead children, the results have been very similar; the lungs, after several attempts, were found to have received only a small quantity of air. Thus, then, it would appear, that the lungs of a new-born child may be inflated in situ, although with some difficulty, and that the quantity of air which they receive under these circumstances, is inconsiderable. If the efforts at inflation are continued for some time in the dead body, and the tube is violently introduced into the larynx or trachea; or if the organs be inflated, after removal from the thorax, with the express intention of causing them to resemble respired lungs, the case is different: but this is not the way in which the objection can possibly occur in a case of infanticide,—a circumstance which appears to have been strangely overlooked by some of those who have examined this alleged objection to the hydrostatic test. It is not likely that a woman, if able to perform the experiment at all, would be capable of doing more than a practised accoucheur; and the probability is, that she would, in general, altogether fail in the attempt. I have been able to find only one case reported, where a woman is stated to have succeeded in artificially inflating the lungs of her child.—(Meckel. Lehrb. der G. M. 368.—See also Ed. Med. and Surg. Jour. xxvi. 374.)

But let it be admitted, that the lungs are artificially inflated; in this case, they would resemble, by their partial distension with air, and other physical characters, those of children which had imperfectly breathed. Like them, they may float on water; but on cutting them into pieces, some of these would be found to sink. If the pieces be firmly compressed either by means of a folded cloth or between the fingers, they will lose their air and sink, so that in fact there are no physical means of distinguishing artificially inflated lungs from those that have imperfectly breathed. Experiment has repeatedly shown that where the respiration has been very feeble and no artificial inflation resorted to, the air may be forced out of the lungs by moderate compression, and the portion so compressed will sink in water. If the compression be performed under water, the bubbles of air may be seen to rise through the liquid. The results I have found to be exactly the same with lungs artificially inflated as they were lying in the chest. (See Guy's Hospital Reports, No. v., and for remarks on this subject by Dr. Christison, see Ed. Med. and Surg. Jour. xxvi. 74.)

If respiration has been *perfectly* established, and the lungs are well filled with air, it is impossible so to expel this air by compressing the divided portions of the organs, as to cause them to sink in water. It has been asserted, that it is equally impossible to force the air out of lungs that have been artificially inflated; but it is highly probable that in these cases the lungs had been inflated to a maximum degree when removed from the thorax, a case in which much difficulty is certainly experienced in expelling the air; but this is not the form in which the objection can ever present itself in a case of infanticide. If the lungs be inflated in the ordinary way, i. e. while lying within the

thorax, there is never, according to my observations, any great difficulty in causing them to lose their air by compression, a result which has been repeatedly demonstrated to the medico-legal classes of Guy's Hospital. Although no reliance can be placed on the effects of compression in cases of *imperfect respiration*, yet it appears to me that when with great weight of the lungs, there is great buoyancy in water, the fact of their not losing the air contained in them, and not sinking after very firm compression, ought to be considered as a good corroborative proof of the child having breathed. It has been just stated, that compression will not extricate air from lungs which have fully respired. By this, it is not to be understood that the experiment of compression can only be practically applied, to distinguish respiration, in those cases in which a child has lived for a considerable time after its birth. I have found it to succeed, even where a child had lived to make no more than one or two respirations, and had died before it was actually born. In this case, it was found necessary to destroy the child while the head was presenting, in order to effect delivery. It lived, however, a sufficient time after the protrusion of its head with the greater part of the brain evacuated, to cry loudly for an instant. The general appearance of the body, showed that it had attained to the full period of gestation. On opening the thorax, the lungs were seen projecting slightly forwards over the sides of the pericardium. They were of a light-red colour, but not crepitant under the finger. They had the external physical characters which these organs are known to acquire on the first establishment of respiration; but the absence of crepitation proved that the process could not have been perfectly performed. The colour of the external surface was throughout uniform; a circumstance which I have never witnessed in lungs that had been artificially inflated, except where the inflation had been carried to its fullest extent out of the body. Then, however, there is, commonly, distinct crepitation.

When removed and placed on water, these organs floated freely; and on being separated, both appeared equally buoyant. Each lung was next divided into sixteen pieces, and every piece floated. In dividing them, it was observed that the colour was uniform throughout their substance; there was no sense of crepitus under the knife; nor could the cells, in which the air was diffused, be seen. The pieces were then subjected to very forcible compression, for a considerable time, in a folded cloth. The cloth was ruptured by the force employed; yet, on removing the pieces, and placing them on water, they all continued to float. A portion of air had, undoubtedly, been forced out, but not sufficient to deprive any of them of their buoyancy. By this we learn, that in some instances, two or three respirations only, may suffice to stamp upon the lungs, characters whereby they may be easily distinguished from those organs that have undergone artificial inflation. The compression was carried to the furthest possible limit consistently with the preservation of the organic structure of the lungs.

It must not be supposed, that, in all children which have lived but a second or two to respire, similar results will be obtained. The respi-

ration of an instant may distend the lungs of one child, as much as respiration, continued for several hours, would those of another. The time which a child has survived its birth, does not allow us to predict, to what degree its lungs will be found distended on inspection, or what the results of experiments on these organs will be. A child may have very feebly respired, and died either in a few minutes or hours, or not until many days have elapsed after its birth. There is, of course, no definite boundary between the perfect and imperfect distension of the lungs, but by the latter condition we may understand that state of the healthy organs in which they contain only sufficient air to render them buoyant in water; and from the slight difference in their specific gravity and that of water, a very small quantity will suffice for this. In these cases, moreover, the colour, volume, and consistency, are scarcely changed from the fœtal condition. The admission, that air may be compressed out of feebly respired lungs by the same means as out of those which have been submitted to artificial inflation, may appear to render compression useless, as a diagnostic sign of artificial inflation; but we must not forget, that other corroborative sources of evidence may be forthcoming. The experiment of compression will I believe, when properly applied, enable us to distinguish cases of complete respiration from those of artificial inflation of the lungs *in situ*; and, if for this circumstance alone, it ought to be regarded as an adjunct, occasionally useful in these investigations.

It must, however, be admitted, that there are no means of distinguishing *feeble respiration* from *artificial inflation*. The physical characters of the lungs will be unaltered; and compression will, in either condition, destroy their buoyancy. In a case of this kind, I apprehend the only course left open to a medical witness is, to state to the jury, that the evidence derived from experiments on the lungs, left it uncertain whether the child in question had respired or had had its lungs artificially inflated. The jury will then know how to return their verdict; for it must be remembered, they have always circumstances to guide their judgment, as well as medical opinions; and it is upon the *whole*, and not upon a part of the evidence laid before them, that their verdict is founded. It is singular that this occasional difficulty of distinguishing artificial inflation from respiration, should have been represented as a serious objection to the employment of the hydrostatic test. Even admitting, in the very few instances in which such a defence on the part of a prisoner is possible, that a practitioner is unable to distinguish the one condition from another, this becomes purely a point for the consideration of a jury; it cannot affect the general application of the hydrostatic test. Examples of this sort of difficulty are by no means uncommon, in the practice of medical jurisprudence. Many instances might be adduced of medical evidence becoming doubtful from circumstances, wholly independent of the skill of the practitioner, and over which he has no possible control. In the determination of any single point in a case of child-murder, whether it relate to live birth or the actual cause of death, a doubt may arise; the question

relative to the respiration of the child, is not exempted from this rule; but it would be the height of inconsistency, to contend, that, because certain means of investigation will not always enable us to express a positive opinion, we should never have recourse to them. I presume that, in the present day, few practitioners would trust to the floating of the lungs as a sign of breathing, before he had ascertained that the air contained in them could not be expelled by compression. The charge against an accused party is not likely, therefore, to be sustained by medical evidence of the respiration of the child, unless the child have actually respired; but it is possible, that, owing to a want of evidence to characterize feeble respiration, a really guilty person may escape upon the bare assumption that the lungs might have been artificially inflated. The mischief to be apprehended is not then, as it has been often alleged, that the employment of the pulmonary tests may lead to the condemnation of an innocent, but rather to the acquittal of a guilty person. This is certainly an unfortunate circumstance; but it is one for which medical science is not yet in a condition to provide an adequate remedy.

In reference to this objection, there are, it appears to me, only two cases which might give rise to some doubt on the source of the air contained in the lungs of a new-born child:—

1. When in a child that has not breathed, the lungs are disproportionately heavy, weighing nine hundred or one thousand grains, and they have been artificially inflated in the attempt to resuscitate it. Unless, in this case, the air were expelled by compression, an inference might be hastily drawn, that the child had probably breathed. The error could only be removed by circumstantial evidence, which, however, is generally sufficient to remove a speculative objection of this kind. But unless the fœtal lungs were highly congested, diseased or of extraordinary size, it is not likely that they would weigh so much as is here supposed. This kind of doubtful case might always be suspected to exist where, with considerable absolute weight, the lungs contained very little air. Let us, however, consider what would be the practical bearing on the question of child-murder, supposing the case not to be cleared up by any of the methods above suggested. 1st, The fact of respiration would not be clearly proved, because the great absolute weight of the lungs, without their being permeated with air, amounts to nothing. 2dly, Although the proof of respiration might not be made out, this would not show that the child was born dead; for we know that a child may live many hours, and yet no evidence of life may be derived from an examination of the lungs. 3dly, Admitting that there was proof of the child having lived after birth, whether there were evidence of respiration or not, the cause of death would have still to be made out: and unless this be clearly traced to the wilful and malicious conduct of the prisoner—proofs of which are not likely to be derived from the body of a child whose lungs she has innocently inflated—she must be acquitted. Thus, then, it is difficult to understand how, in the hands of one who has attended to the subject

of infanticide—and no others ought to be allowed to give medical evidence—this objection, on the ground of inflation, can lead to any difficulty whatever in practice. Such a case, as that which I have here supposed, actually occurred to me in June 1842. A male child, weighing upwards of twelve pounds, died during delivery in a difficult labour. It gave no signs of life when born, and there was no pulsation in the cord. Its lungs were artificially inflated in the attempt to resuscitate it. The organs weighed nine hundred and ninety-four grains. They were slightly crepitant and floated on water, but gentle pressure with the fingers caused them to sink. It was clear that the increased weight depended on their great size, and not on any change wrought by respiration. They contained but a very small quantity of air, which was most easily expelled by pressure.

2. We will now take the converse objection. A child may live and breathe, and its lungs weigh much under the average of respired lungs, i. e., about seven hundred grains. In a case like this, unless the air resisted expulsion by compression, an opposite mistake might be made, and we should pronounce a child that had really breathed and survived birth to have been still-born, and had its lungs artificially inflated. This might happen in numerous cases of imperfect respiration after birth, did we not know that the sinking of the lungs, whether containing air or not, and whether this air be expelled by compression or not, does not necessarily prove that the child was born dead. It can only show, under the most favourable circumstances, that it has either not respired, or respired imperfectly. The sinking of the lungs may take place in a child that has survived birth and has really been murdered; but, in such a case, there might be no proofs of life; and therefore a person actually guilty of a crime, must be discharged for want of sufficient medical evidence to convict. This, however, could no more justify the entire abandonment of medical evidence in such cases, than it could of general evidence; because this, like evidence which is purely medical, is but too often insufficient to bring home guilt to the really guilty. The objection, therefore, on the ground of artificial inflation, when closely examined, is more speculative than real. Admitting, as some contend, that there is no positive criterion to distinguish this condition from respiration, it is difficult to conceive a case in which the objection could be sustained; and if sustained, it never could lead, in the hands of proper witnesses, to the inculpation of the innocent:—unfortunately for society, it would only add another loop-hole to the many that, through the necessary forms of law, now exist, for the escape of the guilty. It is proper to observe, that the results obtained by submitting the lungs to compression in cases of respiration and artificial inflation, have been very different in the hands of experimentalists equally competent. Some have been able to force out the air in both instances,—others in neither case. The discrepancies may depend either upon the different degrees of pressure employed, or upon the actual degree of distension of the lungs. The fact of their existence at any rate shows that the lung tests cannot be safely trusted in the

hands of persons who have not been used to such investigations. It appears to me that there has been a great deal of misplaced discussion on this subject. One case should at least be adduced, where a woman charged with child-murder has been or can be hypothetically exposed to any risk of conviction from the admission that air cannot by compression be forced out of artificially inflated, or that it can be expelled from respired lungs. I am not aware that there is a single instance in our law-records, of such an objection being raised upon any but mere hypothetical grounds, in opposition to all the circumstances of the case. It might be imagined, however, from the discussions among medical jurists, as to the necessity for certain and infallible means of distinguishing artificial inflation from respiration,—that every woman tried for child-murder, had made the praiseworthy attempt to restore a still-born child, although circumstances may show that she had cut its throat, severed its head, or strangled it, while circulation was going on! (See case Prov. Med. Journal, April 23, 1345.) If compression be trusted to as a criterion, without a proper regard to other facts, a practitioner not used to such cases, may be easily led into error, but he may be equally deceived if he adopt the substitute for compression, i. e., if he trust to a mere physical inspection, or to the floating of the lungs in water.

In concluding these remarks upon the objections to the hydrostatic test, it may be observed that medical practitioners have differed much at different times, in their ideas of what it was fitted to prove. About fifty years ago, it would seem that this test was regarded by some as capable of furnishing evidence of murder! Thus we find Dr. Hunter asking the question "How far may we conclude that the child was born alive, *and probably murdered by its mother,* if the lungs swim in water?" Later authorities, and, indeed, many in the present day, assert that the test is capable of proving whether a child has been *born alive* or not! (Beck's Med. Jur. p. 268.) From what has already been stated, as well as from the most simple reflection on the circumstances accompanying the birth of children, I think it must be evident, that the hydrostatic test is no more capable of showing that a child has been born alive or dead, than it is of proving whether it has been murdered, or died from natural causes. The majority of those who have made experiments on this subject, have only pretended to show, by the use of this and other tests, whether or not a child has breathed, —they merely serve to furnish in many cases good proof of life from the state of the lungs; and slight reflection will render it apparent that, in no case are they susceptible of doing more. Even here, their utility is much restricted by numerous counteracting circumstances, a knowledge of which is essential to him who wishes to make a practical application of the facts connected with them. (For a very reasonable view of the pulmonary tests, see Ed. Med. and Surg. Jour. xxvi. 365.) If asked to state in what cases the pulmonary tests are capable of assisting a medical jurist, the answer, it appears to me, would be: —1st, They will clearly show that the new-born child has lived, when,

during its life, it has *fully and perfectly respired.* Cases of this description form a certain number of those which come before our courts of law. To them, the most serious objections are not applicable; and the few which might be made to the medical inferences, are not difficult to answer. 2dly, They will allow a witness to say, that the lungs must have either received air by respiration, or by artificial inflation. These are the cases in which a child has died soon after birth, and where the respiratory changes are but very imperfectly manifested in the lungs. They probably form the large majority of those that fall under the jurisdiction of the criminal law. It might be considered, that the qualification in the inference here drawn, would neutralize its force; but it must be remembered, that there are few instances of actual and deliberate child-murder, wherein artificial inflation could become even a possible defence for an accused party. So unusual is this kind of defence, that among the numerous trials for infanticide which have taken place in this country for many years past, I have not been able to meet with a single instance in which it was alleged, as an objection to the evidence derived from the buoyancy of the lungs, that the prisoner had inflated them in order to resuscitate her child. The reason is obvious: had such a defence been attempted, the whole of the circumstantial evidence would at once have set it aside. When, in the suspected murder of an adult, a medical man swears that a fatal wound was such, that the deceased might have inflicted it on himself, or that the prisoner might have produced it, he is placing the jury in a very similar position to that in which he places them in a case of child-murder, when he says that the child might have breathed, or its lungs might have been artificially inflated. How would a jury decide in the two cases? Assuredly, by connecting together certain facts with which a medical witness has no concern, but which may, in their opinion, satisfactorily supply the place of what is defective in his evidence. It is not for him to calculate the probabilities of respiration, or of artificial inflation; but it is for them to consider, whether an accused party was or was not likely to have resorted to an experiment of this nature. It has been suggested, that some person might inflate the lungs of a dead child, in order to raise a charge of murder against the mother. Such a person must be profoundly versed in the difficulties of medical jurisprudence;—but the question of *murder* does not happen to depend on the presence of air in the lungs. A case of this kind is very unlikely to present itself: indeed its occurrence is no more probable than that in poisoning it should be considered a good defence, that some person might have introduced poison into the stomach after death. The circumstances of the case will commonly furnish a sufficient answer to such hypothetical views.

The hydrostatic test ought not, therefore, to be lightly condemned, or rejected upon a speculative objection, which, in nine-tenths of the cases of child-murder, could not possibly exist. Let it be granted to the fullest extent, that a conscientious medical jurist cannot always draw a positive distinction between respiration and artificial inflation,

still the jury may be in a situation to relieve him from the difficulty In short, it would be as reasonable to contend that all murderers should be acquitted because homicidal are not always to be distinguished from suicidal wounds, as to argue that all cases of infanticide should be abandoned because these two conditions are not to be known from each other by any certain medical signs. If juries do frequently dismiss such cases, it is, I apprehend, to be ascribed rather to their great unwillingness to become the means of administering severe laws, than to their want of power to balance and decide on the probabilities laid before them. If the pulmonary tests were wholly set aside, it is easy to conceive what would be the consequences. Thus, let us suppose that a new-born child is found, under suspicious circumstances, with its throat cut; we are called upon to say, that it is impossible for medical evidence to establish whether the child had lived or not, and therefore we are to decline making an inspection of its body. But this would be the same as declaring that child-murder could never be proved against an accused party, and that new-born children might henceforth be destroyed with impunity! It appears to me, that conduct of this kind, on the part of a medical witness, would be wholly unwarrantable; for we may sometimes acquire, by an inspection, as great a certainty of respiration having been performed, and therefore of a child having lived, as of any other fact of a medico-legal nature. Cases of poisoning often give rise to greater difficulties to a medical jurist; as where, for example, he attempts to found his opinion of the cause of death on symptoms or post-mortem appearances. But we will put the question in this light. In the body of a healthy full-grown child, which has but recently died, we find the lungs filling out the cavity of the chest, of a light-red colour, spongy, crepitant beneath the finger, weighing at least two ounces, and, when divided into numerous pieces, each piece floating on water, even after violent compression? Is it possible in such a case to doubt that respiration has been performed? If there be no certainty here, it appears to me that medical experience is but little fitted in any case to guide us in our inquiries. It would be difficult to point out an instance in which an affirmative medical opinion, would be more surely warranted by the data upon which it was founded.

It has been already stated that the pulmonary tests are only fitted to prove whether the child has or has not *lived to respire*. Neither the hydrostatic nor any other test can positively show that the child was entirely *born alive* when the act of respiration was performed. As this is a subject which generally gives rise to some discussion in cases of child-murder, I shall here make a few remarks on it:—1st, Respiration may be performed while the child is in the uterus, after the rupture of the membranes;—the mouth of the child being at the os uteri. This is what is termed *vagitus uterinus;* its occurrence, although extremely rare, seems to me, to rest upon undisputed authority. 2ndly, A child may breathe while its head is in the vagina, either during a presentation of the head or the breech. This has been termed *vagitus vaginalis*. It is not very common, but it must be set down as a possible

occurrence. 3dly, A child may breathe while its head is protruding from the outlet; in this position, respiration may be as completely set up in a few moments, by its crying, as we find it in some children that have actually been born, and have survived their birth for several hours. This is the most usual form of respiration before birth. In the *vagitus uterinus or vaginalis*, the lungs receive but a very small quantity of air; in respiration after protrusion of the head, the lungs may be sometimes found moderately well filled; although never, perhaps, possessing all the characteristic properties of those which have fully respired. The well-known occurrence of respiration, under either of these three conditions, strikingly displays the fallacy of making that process, as some have done, the certain criterion of extra-uterine life. A child may breathe in the uterus or vagina, or with its head at the outlet, and die before its body is born; the discovery of its having respired would not, therefore, be any sort of proof of its having enjoyed what has been termed "extra-uterine life." The death of a child which has respired in the uterus or vagina from natural causes, before its entire birth, is a possible occurrence; but its death from natural causes before birth, after it has breathed by the protrusion of its head from the outlet, is, I believe, a very unusual event. All that we can say is—it may take place; but its death, under these circumstances, would be the exception to a very general rule. Oberkamp, in four successive deliveries of the same female, observed that the children breathed before delivery, but died before they were born. A case of this kind also occurred to Diemerbroek. (See Meckel. Lehrbuch der G. M. p. 367; Beck's Med. Jur. 277; also, Ed. Med. and Surg. Jour. xxvi. 374.) The cases reported in Beck, of which there are three, lose much of their value from the fact that the lungs were not examined.

The hydrostatic test is only capable of determining that *respiration has taken place:* it cannot show whether that process was established during birth, or afterwards. The fact of a child having the power of breathing before it is entirely born, does not therefore constitute the smallest objection to its employment; although, upon this ground, we find the use of it, in any case, denounced by many eminent men of the medical and legal professions. Thus, Archbold says, "Very little confidence is placed in this test as to the lungs floating, particularly if the child were dead any length of time before the experiment was made." (Criminal pleading, 367.) Matthews speaks of the test as being "quite exploded." (Digest, 251.) And Jervis makes the same remark. (On coroners, 127.) It is obvious that most members of the law who have treated this subject, have adopted, without sufficient examination, the statements of Dr. William Hunter. This author observes: "A child will commonly breathe as soon as its mouth is born or protruded from the mother; and, in that case, may lose its life before its body be born, especially when there happens to be a considerable interval between what we may call the birth of the child's head and the protrusion of its body. And if this may happen where the best assistance is at hand, it is still more likely to happen when there

is none—that is, where the woman is delivered by herself." (On the uncertainty of the Signs of Murder in the case of Bastard Children, p. 33.) Dr. Hunter here exposes, in plain language, the fallacy of trusting to signs of respiration alone, as evidence of a child having been *born* alive. The truth of his remarks is, in the present day, generally admitted; and if, among medico-legal writers, we find some still treating of respiration as a certain proof of live birth, it is from their not having sufficiently considered the probability of a child breathing, and dying before its body is entirely extruded. But we may ask, How does the admission of these views affect a case of deliberate child-murder? A living and breathing child may be wilfully destroyed before its body is entirely born, as well as afterwards; and if the law of England does not contemplate the wilful destruction of a living and breathing child, before its entire birth, as a crime, this omission cannot be imputed as a fault to the medical jurist; nor can it at all diminish the real value of the hydrostatic test, as furnishing indisputable evidence of *life*. Most persons might consider the crime of murder sufficiently made out, when the medical evidence showed that the child had lived, and that it was *living* when *criminally destroyed*. If, however, this do not constitute infanticide in law; and evidence be further insisted on, to set forth *where* the child was actually living when murdered—whether half protruding from the vagina, or altogether external to the body of the mother; then is the fact of a child respiring before birth, an objection rather against the principles of the law, than against the tests used to determine the presence of life. In a case tried a few years since, in which a child had been found with a ligature firmly tied around its neck, the medical evidence showed clearly, that it had breathed; and the whole of the appearances in its body, were such as to leave no medical doubt that it had died by strangulation. The judge, in charging the jury, said, "if they were of opinion that the prisoner *had strangled her child before it was wholly born, she must be acquitted of the murder!*" The prisoner was acquitted. However we may regard the question of the utility of pulmonary tests, we cannot but look upon that law, as but very imperfectly adapted to its purposes, which makes the proof of murder to rest, not upon the actual and wilful destruction of a living child, but upon the precise moment which a murderer may select for the accomplishment of the crime. Impunity is thus held out to all offenders, who destroy living children in the act of birth; but there is an additional evil, accompanying the operation of this legal rule, which seriously affects the medical evidence, given on these occasions. It would seem from cases to be presently related, that the law will assume, until the contrary appear from other circumstances, that the respiration of a child, if proved by the best of evidence, was carried on before it was entirely born. Let the witness, then, in a case of alleged infanticide, ever so clearly establish the fact of respiration, and therefore of life, at the time the violence was used, this evidence is not sufficient. He is asked whether he will depose that the child had breathed

after its body was entirely in the world. Unless he can make this deposition—which, for obvious reasons, he cannot be in a condition to do—it will be presumed that, although the child had breathed, it came into the world dead. In this way, we perceive, a shield is effectually thrown around those who may have been really guilty of destroying their children immediately after birth. Under any moral consideration of the circumstances, I think it impossible to admit, that a woman who kills her child in the act of birth is less guilty of murder than she who chooses the moment of its entire expulsion to destroy it;—any such distinction carried to its full extent, must virtually go to the entire abrogation of the law. It is quite necessary that medical witnesses should know what they are required to prove on these occasions; and the following cases will, perhaps, serve to place this matter in a clear light.

In the case of *Rex v. Poulton*, good medical evidence was given to show that the child was living, when the violence was offered to it. Of three medical witnesses, who were called, the first said in answer to questions put to him: It frequently happens that the child is born as far as the head is concerned, *and breathes*, but death takes place before the whole delivery is complete. My opinion in this case is, that the child had breathed, but I cannot take upon myself to say, that it was wholly born alive. The second said, that death might have occurred when the child was partly born, if no medical man was present to assist in the delivery. The third witness said, It is impossible to state when the child respired; but there is no doubt from the condition of the lungs, when they were examined, that the child had breathed; children may breathe during the birth. (Chitty, Med. Jur. 412.) The evidence here given, shows that the witnesses were intelligent men; and that they had duly reflected upon what the hydrostatic test is really capable of proving. The judge held that this medical evidence was not sufficient:—"something more was required than to show that a child had respired in the progress of its birth; it must be proved that the *whole body* of the child was brought into the world. (See Matthew's Digest, Supp. 25; also, Archbold, Crim. Plea. 367.) In the case of *Rex v. Simpson*, tried at Winchester, in March 1835, Baron Gurney would not allow the case to proceed against a prisoner so soon as the medical witness stated that the lungs of a child might become distended by the act of respiration during birth. *In Rex v. Brain*, it was held, that a child must be wholly in the world in a living state to be the subject of murder; and in that of *Rex v. Sellis* (Norfolk Spring Circuit, 1837) Mr. Justice Coltman held, that to justify a conviction for child-murder, the jury must be satisfied that the entire body of the child was actually in the world in a living state, when the violence was offered to it. But Mr. Baron Parke has pronounced a more decided opinion on this point, than any of the other judges. In relation to an important case of infanticide, tried at the Herts Lent Assizes, 1841, (See Guy's Hospital Reports, April 1842,) he thus charged the grand jury: "With respect to all these cases (of infanticide,) there is a degree of doubt whether the infant has been *born* alive. The law requires that this should be *clearly proved*, and that the whole body of the child should have come from the body of the parent. If it should appear that death was caused *during delivery*, then you will not find a true bill!" (See also another case, Prov. Med. Journal, April 23, 1845.)

From these decisions it will be seen, that it is not sufficient for a medical witness to declare, from the state of the lungs, that the child was alive at or about the time of its birth; according to the present views of our judges, it is indispensably necessary for him to prove

that the child was *born* alive, or that it was living after its body had *entirely* come into the world.

CHAPTER XLI.

ON THE PROOFS OF A CHILD HAVING BEEN BORN ALIVE.

1. EVIDENCE FROM RESPIRATION.—There will, in general, be no difference in the state of the lungs, whether the act of respiration be performed by the child during parturition or after it is born. But should we find that this process has been completely established, i. e. that the lungs present all those conditions which have been described as characteristic of full and perfect respiration, there is great reason to presume, that the process, even if it commenced during birth, must have continued after the child was entirely born. This presumption becomes still stronger, when the child is immature; for generally speaking, such children must be born and continue to respire for many hours after birth, in order that their lungs should present the characters of complete respiration. The process is seldom so established before birth, as to give to these organs the feeling of crepitation under pressure; the existence of this character should, therefore, be sought for. A witness who relied upon it as a conclusive proof of respiration *after* birth, might be asked by counsel, whether it were not possible for some children to remain so long at the outlet with the head protruding, as to render the lungs crepitant from frequent respiration *before* birth. Admitting the possibility of this occurrence, he should endeavour to ascertain, whether there were any probable causes thus to protract delivery, while the head of the child was in this position; as also what natural cause could have produced its death when its head was protruding and respiration had been so freely performed as to give crepitation to the lungs.

2. EVIDENCE FROM MARKS OF VIOLENCE.—If marks of violence apparently inflicted about the same time, be found on different and distinct parts of the body, and these marks bear the characters of those produced during life, (antè, p. 288,) it is rendered probable that the whole of the body of the child was in the world, when they were caused. Marks of severe violence on one part, as the head or breech, would not justify such a presumption, because it may be fairly objected that they might have been unintentionally produced by the woman in her attempts at self-delivery, and yet the child not have been born alive. It would be for a witness to form an opinion whether they had been thus occasioned, from the circumstances accompanying

the particular case. From this, it will be seen, that in making a post-mortem examination, it is proper that every mark of injury on the body of a child, should be noted down.

3. EVIDENCE FROM CERTAIN CHANGES IN THE BODY.—In a child which has been born alive or which has survived its birth, that portion of the umbilical cord which is contiguous to the abdomen, undergoes certain changes:—thus it becomes slowly corrugated and separates with or without cicatrization. The umbilical vessels become, at the same time, contracted. It has also been observed that the ductus arteriosus is contracted either in the centre or at its aortal termination;—and that the foramen ovale in the septum of the auricles becomes closed. There is no doubt that these changes, when they exist, clearly prove that a child has survived its birth, whatever may be the results of experiments on the lungs; but the difficulty is, that they require some days for their development, and in practice, it is necessary to procure some sign of a survivorship of only a few minutes, or at farthest of a few hours. The same remark applies to the exfoliation of the cuticle in a new-born child: such a condition of the skin can very rarely be found in cases of infanticide. The absence of meconium from the intestines, and of urine from the bladder, are not proofs of live birth, for these may be discharged during birth, and yet the child not be born alive. Perhaps better evidence may be derived from the discovery of certain liquids or solids in the stomach and intestines, such as blood, milk, or other articles of food; for it is not likely that these would be introduced or swallowed during parturition, nor is it at all probable that they should find their way into the stomach or intestines of a child which was really born dead. Dr. Geoghegan informed me of the case of a new-born child, in which he discovered, by the application of iodine water, the presence of farinaceous food in the stomach, whereby the question of live birth was clearly settled in the affirmative. An instance is related by Dr. Döring, where a spoonful of coagulated blood was found in the stomach of a new-born child. The inner surface of the œsophagus and trachea was also covered with blood. Dr. Döring inferred from these facts, that the child had been born alive; for the blood, in his opinion, must have entered the stomach by swallowing, after the birth of the child, and while it was probably lying with its face in a pool of blood. (See on this subject Henke's Zeitschrift, 1842, ii. 219.)

The slightest consideration will show that the signs of live birth above described, are weak, unsatisfactory, and of purely incidental occurrence. If the child be destroyed during birth or within a few minutes afterwards, there will be no medical evidence to indicate the period at which its destruction took place. The external and internal appearances presented by the body, would be the same in the two cases. It is most probable that in the greater number of instances of child-murder, the child is actually destroyed during birth, or immediately afterwards; and, therefore, the characters above described can rarely be available in practice. If any exception be made, it is with respect

to the nature, situation and extent of marks of violence; but the presence of these depends on mere accident. Hence, then, we come to the conclusion, that although medical evidence can often show from the state of the lungs, that a child has really lived, it can very rarely be in a condition to prove in a case of infanticide, that its life certainly continued after its birth. Why the destruction of a child should be treated in the one case as a venial offence, and in the other as a capital crime, is one of those anomalies in our criminal jurisprudence for which it is impossible to account. The inference which we may draw from these observations is, that if positive proof of entire live birth, be in all cases rigorously demanded of medical witnesses on trials for child-murder, it is quite impossible, where the prisoner is ably defended, that any conviction for the crime should ever take place. The only exception would be, where a confession was made by the accused, or the murder was perpetrated before eye-witnesses. The numerous acquittals that take place on trials for this crime, in face of the strongest medical evidence, bear out the correctness of this opinion.

CHAPTER XLII.

HOW LONG DID THE CHILD SURVIVE ITS BIRTH? HOW LONG HAS IT BEEN DEAD

If we suppose it to have been clearly established, that the child not only lived but was actually born alive, it may be a question whether it lived for a certain number of hours or days after it was born. The answer to this question may be necessary in order to connect the deceased child with the supposed mother. It has been remarked that scarcely any appreciable changes take place in the body of a child, until after the lapse of twenty-four hours; and these changes may be considerably affected by its degree of maturity, healthiness and vigour.

1. After twenty-four hours.—The skin is firm and pale, or less red than soon after birth. The umbilical cord becomes somewhat shrivelled, although it remains soft and blueish-coloured from the point where it is secured by a ligature, to its insertion in the skin of the abdomen. The meconium is discharged; but a green-coloured mucus is found on the surface of the large intestines. The lungs may be more or less distended with air, although in a case of survivorship for a period longer than this, no trace of air was found in them. With regard to the state of the lungs, it should be remembered, that when

these organs are fully and perfectly distended, the inference is that the child has probably survived many hours; but the converse of this proposition is not always true. Many cases already reported, show that where the lungs contain a very small quantity of air, it does not follow that the child must have died immediately after it was born, (antè, p. 452.)

2. From the second to the third day.—The skin has a yellowish tinge,—the epidermis sometimes appears cracked, a change which precedes exfoliation. (Devergie, i. 519) The umbilical cord becomes brown and dry between the ligature and the abdomen.

3. From the third to the fourth day.—The skin is more yellow, and there is evident exfoliation of the cuticle on the chest and abdomen. The umbilical cord is of a brownish red colour, flattened, semi-transparent and twisted. The skin in contact with the dried portion presents a ring of vascularity or redness;—but Dr. Geoghegan met with this appearance in two cases of still-born children, and I have also seen it in four cases where the children were born dead. (G. H. Rep. April 1842.) The colon is free from any traces of green mucosity.

4. From the fourth to the sixth day.—The cuticle in various parts of the body is found separating in the form of minute scales or of a fine powder. The umbilical cord separates from the abdomen usually about the fifth day, but sometimes not until the eighth or the tenth. The membranous coverings become first detached, then the arteries, and afterwards the vein. The ductus arteriosus may be found contracted both in length and diameter: the foramen ovale may be also partly closed. The changes which take place in the ductus arteriosus and foramen ovale, have been especially observed by Bernt of Vienna. According to him, if a child respire only for a few seconds, the duct becomes contracted at one of its extremities, commonly at the aortal end:—although this is perhaps generally true, yet cases have fallen under my observation, where there was no perceptible change in the diameter of the duct, and yet the children had respired for some time after birth. In instances of feeble respiration, such a change can hardly be looked for. The same remarks will apply to the contraction of the foramen ovale.

5. From the sixth to the twelfth day.—The cuticle will be found desquamating on the extremities. If the umbilical cord was small, cicatrization will have taken place before the tenth day after birth. If large, a sero-purulent discharge will sometimes continue for twenty-five or thirty days. The ductus arteriosus is said to become entirely closed during this period; but it has been found pervious many years after birth, and it is probable that in many subjects some months elapse before it is entirely obliterated. The fact of its being found pervious, can therefore furnish no certain evidence, The closure of the foramen ovale is equally uncertain, as to the time of its occurrence. According to Billard it becomes closed in the greater number of instances between the second and third days: but there are numerous

cases in which the closure does not take plaee. Dr. Handyside states that it is open in one case out of eight. In 1838, two subjects were examined at Guy's Hospital, one aged fifty, the other eleven years, and in both the foramen ovale was found open. We may say of this aperture, as of the arterial duct,—when contracted or closed, it furnishes certain evidence of a child having survived birth, for how long a period above two or three days it is impossible to say:—but when found unclosed, as it probably would be in the generality of cases of infanticide, it is susceptible of furnishing no evidence whatever.

On the whole, it will be seen that the signs of survivorship for short periods after birth, are not very distinct. The changes stated to take place during the first twenty-four hours in the umbilical cord, may be observed in the dead as well as in the living child; and the other changes occur with much uncertainty as to the period. These are, however, I believe the principal facts upon which a medical opinion on such a subject can be based, and it is in some respects fortunate, that great precision in assigning the time of survivorship, is not demanded of medical witnesses.

A practitioner may be further required to state *how long a period has elapsed since the death of the child.* The answer to the previous question, was derived from the changes which take place in the body of a child during life, while in relation to the present inquiry, we must look to those which occur in the body after death:—in other words, to the different stages of putrefaction. From the observations of Orfila, it would appear that the body of an infant putrefies more rapidly than that of an adult. (Traité des Exhumations.) In forming a judgment on this point, due allowance must be made for the influence of temperature and humidity. If the body has been sunk in water, putrefaction takes place more slowly than usual, and the process is slower in running than in stagnant water. When the body is floating on the surface of water, so as to be at the same time exposed to air, then putrefaction takes place very rapidly:—and this also happens, when the body, after removal from water, has been allowed to remain for some time exposed to air. Putrefaction is also retarded when the deceased child has been buried in the ground in a box or coffin, unless the process had already commenced prior to interment. When the body has been cut up and mangled before being thus disposed of, putrefaction takes place with much greater rapidity. (The *Queen* v. *Railton.* Stafford Winter Assizes, 1844.)

CHAPTER XLIII.

DEATH OF THE CHILD FROM NATURAL CAUSES.

The next important question in a case of infanticide, and that upon which the charge of murder essentially rests is,—what was the cause of death? 1. It is admitted that a child may die during birth or afterwards. 2. In either of these cases it may die from natural or violent causes. The violent causes may have originated in accident or in criminal design. The last case only, involves the corpus deliciti of child-murder. If death has clearly proceeded from natural causes, it is of no importance to settle whether the cause operated during or after birth :—all charge of criminality is thenceforth at an end.

It is well known that of children which are born under usual circumstances, a great number die from natural causes either during birth or soon afterwards : and in every case of infanticide, death will be presumed to have arisen from some cause of this kind, until the contrary appear from the evidence. This throws the onus of proof entirely on the prosecution. Many children die before performing the act of respiration; and thus a large number come into the world still-born, or dead. The proportion of still-born among legitimate children, as it is derived from statistical tables extending over a series of years and embracing not less than eight millions of births, varies from one in eighteen to one in twenty. (B. and F. Med. Rev. No. vii. 234.) Dr. Lever found out of three thousand births, that one in eighteen was born dead. In immature and illegitimate children the proportion is much greater, probably about one in eight or ten. In Göttingen they were found to amount to one in seven, and in Berlin, to one in ten. (Ed. Med. and Surg. Journ. xxvi. 172.) Males are more frequently born dead than females, in the ratio of 140 : 100,—while the males to females born, has only a ratio of 106 : 100. (Dr. Simpson, Ed. Med. and Sur. Journ., Oct. 1844, 395.) The preponderance of still-births among males is owing to the greater size of the head. Still births are much more frequent in first than in after pregnancies. These facts should be borne in mind, when we are estimating the probability of the cause of death being natural. When respiration is established by the protrusion of the child's head or the birth of its body, the chances of death from natural causes are considerably diminished. Nevertheless, as Dr. Hunter long ago suggested, a child may breathe and die. Thus, according to this author;—"If the child makes but one gasp and instantly dies, the lungs will swim in water, as readily as if it had breathed longer and had then been strangled." In general, it would require more than one gasp to cause the lungs to swim readily in water; but granting this point, the real question is,—if this child

breathed after birth, what could have caused its death? The number of gasps which a child may make, or which may be required for the lungs to swim in water, is of no moment:—the point to consider is, whether its death was due to causes of an accidental or criminal nature. So again observes Dr. Hunter; "We frequently see children born, who from circumstances in their constitution or in the nature of the labour, are but barely alive, and after breathing a minute or two or an hour or two, die in spite of all our attention. And why may not this misfortune happen to a woman who is brought to bed by herself?" (Op. Cit.) The substance of this remark is, that many children may die naturally after birth; and in Dr. Hunter's time, these cases were not perhaps sufficiently attended to. In the present day, however, the case is different:—a charge of child-murder is seldom raised unless there be the most obvious marks of severe and mortal injuries on the body of a child; and unless it be intended to defend and justify the practice of infanticide, it must be admitted that the discovery of violence of this kind on the body of an infant, renders a full inquiry into the circumstances necessary. Among the natural causes of the death of a child, may be enumerated the following:

1. A PROTRACTED DELIVERY.—The death of a child may proceed in this case, from injury suffered by the head during the violent contractions, of the uterus. or from an interruption to the circulation in the umbilical cord before respiration is established. A child, especially if feeble and delicate, may die from exhaustion under these circumstances. This cause of death may be suspected, when a sero-sanguinolent tumour is found on the head of a child, and the head itself is deformed or elongated:—internally by the congested state of the cerebral vessels. The existence of deformity in the pelvis of the woman might corroborate this view; but in primiparous females (among whom charges of child-murder chiefly lie,) with well-formed pelves, delivery is frequently protracted. It is presumed that there are no marks of violence on the body of the child, excepting those which may have arisen accidentally in attempts at self-delivery.

2. DEBILITY.—A child may be born prematurely or at the full period, and not survive its birth owing to a natural feebleness of system. This is especially observed with immature children; and it is the condition more particularly dwelt on by Dr. Hunter. Such children may continue in existence for several hours, feebly respiring, and then die from mere weakness. These cases may be recognized by the appearance of a general want of development in the body.

3. HÆMORRHAGE.—A child may die from hæmorrhage, owing to a premature separation of the placenta or an accidental rupture of the umbilical cord. In the latter case it is said the loss of blood is not likely to prove fatal, if respiration have been established; but an instance is reported where a child died from hæmorrhage even under these circumstances. (Henke's Zeitschrift 1839, Erg. H. 200: also 1840, i, 347 and ii. 105. Ann. D'Hyg. 1831. 128.) Death from hæmorrhage may be commonly recognized by the blanched appearance of the body, and

a want of blood in the internal organs. It was formerly a debated question whether in the event of the umbilical cord being left untied after cutting or laceration, such a degree of hæmorrhage could occur as would prove fatal to a child. The case just referred to, renders it unnecessary to discuss this question. Hæmorrhage is more likely to prove fatal, when the cord is divided by a sharp instrument, than when it is lacerated; and its dangerous effects on the child are great in proportion as the division is made near to the umbilicus. It has been improperly described as a case of infanticide by omission, where a self-delivered woman neglects to apply a ligature to the cord under these circumstances; because it is said she ought to know the necessity for this in order to prevent the child dying from hæmorrhage. Such a doctrine assumes not only malice against the accused, but that in the midst of her distress and pain, she must necessarily possess the knowledge and bodily capacity of an accoucheur, a doctrine wholly repugnant to the common feelings of humanity. This question was actually raised in the case of the *Queen* v. *Dash*, Aug. 1842. There was no doubt that the child had breathed, and that its death had been caused by hæmorrhage from the lacerated umbilical cord. The medical witness properly admitted, that the cord might have been torn through by the weight of the child during labour; and the jury acquitted the prisoner on the ground that she might have been ignorant of the necessity or not have had the power to tie the cord.

4. Compression of the cord.—When a child is born by the feet or buttocks, the cord may be so compressed under strong uterine contraction, that the circulation between the mother and child will be arrested, and the latter will die. The same fatal compression may follow, when during delivery the cord becomes twisted round the neck. A child has been known to die under these circumstances before parturition, the cord having become twisted round its neck in utero. (Med. Gaz. Oct. 1840, 122.) Other cases of death from this cause, during delivery, will be found in the same journal, (Vol. xix. 232, 933.) On these occasions, the child is sometimes described to have died from strangulation; but it is evident that before the establishment of respiration, such a form of expression is improper. There are few or no appearances indicative of the cause of death. There may be lividity about the head and face, and cerebral congestion internally; but it is proper to state, that the brain of a child is always more congested than that of an adult.

5. Malformation.—There may be a deficiency of some vital organ, which would at once account for the child dying either during delivery or soon after its birth. Two cases are reported, in one of which the child died from an absolute deficiency of the œsophagus,—the pharynx terminating in a cul-de-sac; in the other, the duodenum was obliterated for more than an inch, and had occasioned the child's death. (Med. Gaz. xxvi. 542.) There can be no difficulty in determining whether the malformation be such as to account for death. Individuals are not allowed to destroy these monstrous births; and

the presence of marks of violence in such cases, should be regarded with suspicion. See on this cause of death a singular case by Dr. Fairbairn. (Northern Jour. Med. March, 1845, p. 278.)

6. Congenital disease.—It has been elsewhere stated, that a child may be born labouring under such a degree of congenital disease, as to render it incapable of living (anté, p. 452.) The discovery of any of the fœtal organs merely in a morbid condition, amounts to nothing, unless the disease has advanced to that degree to account for death. There are, doubtless, many obscure affections, particularly of the brain, which are liable to destroy the life of a child without leaving any well-marked post-mortem changes. According to Dr. Burgess, apoplexy and asphyxia are very common causes of death among new-born children. (Med. Gaz. xxvi. 492. Henke's Zeitschrift, der S. A. 1843, p. 67.) Probably diseases of the lungs are of the most importance in a medico-legal view; because by directly affecting the organs of respiration, they render it impossible for a child to live, or to survive its birth for a long period. These diseases are principally congestion, hepatization, tubercles, scirrhus and œdema,—the existence of any of which, it is not difficult to discover. They render the structure of the lungs heavier than water; and thus prevent the organs from acquiring that buoyancy which in their healthy state they are known to have. (See ante, p. 450.) It is not common to find the lungs diseased throughout:—a portion may be sufficiently healthy to allow of a partial performance of respiration. The lungs may not be found diseased; but simply in that condition which has been elsewhere described un- the name of the atelectasis, (ante, p. 452.) The causes upon which this condition of the lungs depends, are not well understood. The non-establishment of respiration, sometimes arises from the mouth and fauces of the child being filled with mucus.

CHAPTER XLIV.

DEATH OF THE CHILD FROM VIOLENT CAUSES. WHETHER THE VIOLENCE WAS OF ACCIDENTAL OR CRIMINAL ORIGIN.

We shall here have to consider all those modes of death, which are totally independent of the existence of congenital disease or other natural causes. There are certain forms of child-murder which are not necessarily attended with any appearance indicative of violence,—these are suffocation, drowning, exposure to cold,—and starvation.

1. Suffocation.—This is a very common cause of death in new-born children. A wet cloth may be placed over the child's mouth, or thrust into that cavity during birth or afterwards, and before or after the performance of respiration. To the latter case only, could the term suffocation be strictly applied. A child may be thus destroyed by being allowed to remain closely compressed under the bed-clothes after delivery, or by its head being thrust into straw, feathers and such like substances. The post-mortem appearances are seldom sufficient to excite a suspicion of the cause of death unless undue violence have been employed. There is commonly merely lividity about the head and face, and slight congestion in the lungs. A careful examination of the mouth and fauces should be made, as foreign substances are sometimes found in this situation, affording circumstantial evidence of the mode in which the suffocation has taken place. Thus wool, straw, feathers, dust or a hard plug of linen, may be, and in some cases have been found blocking up the mouth and fauces. Again, a child may be suffocated by having its head held over mephitic vapour, as in the exhalations of a privy or of burning sulphur. There are few of these cases in which a medical opinion of the cause of death could be given, unless some circumstantial evidence were produced and the witness were allowed to say, whether the alleged facts were sufficient to account for death. (Annales D'Hyg., 1832, 621.)

On the other hand, if it be even clearly proved that death has been caused by suffocation, it must be remembered that a child may be accidentally suffocated, and the crime of murder falsely imputed. Dr. Hunter who was well aware of the risk to which a female might be thus exposed, observes in relation to this point,—"When a woman is delivered by herself, a strong child may be born perfectly alive, and die in a very few minutes for want of breath, either by being on its face in a pool formed by the natural discharges or upon wet clothes;—or by the wet things over it collapsing and excluding air, or drawn close to its mouth and nose by the suction of breathing, An unhappy woman delivered by herself, distracted in her mind and exhausted in her body, will not have strength or recollection enough to fly instantly to the relief of her child." (Op. cit. 35.) It may be added that a primiparous female may faint or become wholly unconscious of her situation; or if conscious, she may be ignorant of the necessity of removing the child, and thus it may be suffocated without her having been intentionally accessary to its death. In such cases, however, there should be no marks of violence on the body, or they should be of such a nature and in such a situation, as to be readily explicable on the supposition of an accidental origin. A young infant is very easily destroyed by suffocation. If the mouth and nostrils be kept covered for a very few minutes, by being closely wrapped in clothes, asphyxia may come on without this being indicated by convulsions or any other marked symptoms. Suspicions of murder may arise in such cases; but the absence of marks of violence, with an explanation of the circumstances, will rarely allow the case to be carried beyond an inquest.

Sometimes the body is found mal-treated, with marks of strangulation about it,—concealed in a feather-bed or privy;—or cut up and burnt. This kind of violence may properly excite a suspicion of murder, and lead to the belief that the allegation of death from accidental suffocation, was a mere pretence. This, however, is purely a question for the jury and not for the witness. Unless the case be of a very glaring nature, the violence is considered to have been employed for the purpose, rather of concealing the birth of the child than of destroying it. In the present day, these cases of death from accidental suffocation, when properly investigated, can never implicate an innocent woman in a charge of murder; although the facts may show in many instances, that the death of the child was really due to great imprudence, neglect or indifference.

The following case, (the *Queen* v. *Mortiboys*,) tried at the Summer Assizes, in 1841, will show that even when the evidence is very strong against a person, the circumstances will be favourably interpreted. In this instance, it was proved that the body of the child was discovered in a box containing wool:—it was lying on its abdomen with its face raised and its mouth open. A red worsted comforter had been passed twice round the neck, and was tied the second time in a single knot over the chin. In the mouth, which was open, was found a small quantity of fine flocks of wool. The medical evidence showed that the child had been born alive, the left lung being fully inflated. The brain was congested. There was no mark produced by the ligature on the neck, either externally or internally. Death was referred to obstructed respiration, (suffocation,) caused partly by the ligature and partly by the wool in the mouth,—but the latter was considered to be the more active cause. In the defence, it was urged that the ligature could not have produced strangulation, because the comforter was tied upon the chin, —that the medical evidence showed the wool in the mouth to have been the more active cause of death,—this was probably taken into the mouth by the child itself in the instinctive action of breathing, and not put there by the prisoner for the purpose of suffocation. The child had probably been placed carelessly on a quantity of wool, into which it had sunk by its own weight, and this had caused its death. It is reported, that the judge joined in this view, and in charging the jury, said, that had the prisoner intended to choke the child with the wool, she would have inserted enough to fill its mouth. The prisoner was acquitted. In this case, admitting that the evidence did not bear out the charge of murder, still it is pretty clear that death was caused by the child being placed on its face in a closed box filled with wool and with a ligature round the neck. There appears here, admitting the facts to have been as represented, something more than an accident: for the prisoner must have known that a new-born infant was not likely to live under such circumstances, and had it been a week or a month old she would probably have been convicted of manslaughter or murder. A very interesting case of alleged infanticide, by suffocation, has been recently reported by Dr. Easton, (Cormack's Journal, Feb. 1845.) There is no doubt that the child in this case was suffocated by a quantity of mud being forced into its mouth and fauces. Its presence in the œsophagus was incompatible with its having entered by gravitation. In the case of *Mackintyre*, Glasgow Aut. Circ., 1829, several small pieces of straw were found in the stomach of the child, of the same kind as those which were in the bed where the birth took place.

2. Drowning.—The fact of drowning cannot be verified by any ap-

pearances on the body of a child which has not breathed. Thus, if a woman caused herself to be delivered in a bath, and the child were forcibly retained under water, (a case which is said to have occurred,) it would of course die; but no evidence of the mode of death would be found on the body. For a case in which a child was thus destroyed, probably however through accidental circumstances, see Cormack's Ed. Jour., October, 1845, p. 796. After respiration, the signs of drowning will be the same as those met with in the adult. (See post, DROWNING.) The main question for a witness to decide, will be whether the child was put into the water living or dead. Infanticide by drowning is by no means common:—the child is generally suffocated, strangled, or destroyed in other ways, and its body is then thrown into water, in order to conceal the real manner of its death. The finding of the dead body of an infant in water, must not allow the witness to be thrown off his guard, although a verdict of "found drowned," is so commonly returned in these cases. The body should be carefully inspected, in order to determine what was really the cause of death. All marks of violence on the bodies of children that have died by drowning, should be such as to have resulted from accidental causes. It is not necessary, that the whole of the body should be submerged, in order that a child should be destroyed by drowning. The mere immersion of the head in water, will suffice to produce all the usual effects. A case occurred in London, in 1842, where a woman attempted to destroy her child by immersing its head only, in a bucket of water. The child was discovered and resuscitated.

New-born children may be drowned or suffocated by being thrown into mud or into the soil of a privy. Sometimes the child is destroyed in other ways, and its body is thus disposed of for the purposes of concealment. Should there be a large quantity of liquid present, the phenomena are those of drowning. This liquid abounding in hydrosulphuret of ammonia, may then be found, if the child were thrown in living, in the air-passages and the stomach. On these occasions, the defence may be, 1, that the child was born dead, and that the body was thrown in for concealment; but the medical evidence may show that the child had breathed and had probably been born living. 2. It may be alleged that the child breathed for a few moments after birth, but then died, and that the female thus attempted to conceal the body. A medical witness may be here asked, whether a woman could have had power to convey the body to this place,—a point which must, as a general rule, be conceded. 3. It is most commonly urged, that the woman being compelled to go to the privy, was there delivered unconsciously, and that the child dropped from her and was suffocated. All these circumstances may readily occur, but on the other hand the explanation may be inconsistent with medical facts. Thus the head or the limbs of the child may be found to have been separated or divided by some cutting instrument,—or a cord or other ligature may be found tightly bound around its neck. Then again the body may be entire, but the umbilical cord may be found *cleanly cut.* This

would tend to set aside the explanation of the child having accidentally dropped from her; because in such a case, the cord should be found *ruptured.*

On these occasions, a witness will often find himself questioned respecting the strength or capability for exertion, evinced by the lower class of women, shortly after child-birth. Alison observes, that many respectable medical practitioners, judging only from what they have observed among the higher ranks, are liable to be led into an erroneous opinion, which may be injurious to an accused party. He mentions a case, where a woman charged with child-murder, walked a distance of twenty-eight miles in a single day, with her child on her back, two or three days after her delivery. (Case of *Anderson*, Aberdeen Spring Circ., 1829.) Instances have even occurred in which women have walked six and eight miles on the very day of their delivery, without sensible inconvenience. (Criminal Law, 161.) In one case, (*Smith*, Ayr Spr. Circ., 1824,) the woman was engaged in reaping,—retired to a little distance, effected her delivery by herself, and went on with her work for the remainder of the day, appearing only a little paler and thinner! In the case of *Macdougal*, (Aberdeen Spring Circ., 1823,) the prisoner, who was sleeping in bed with two other servants, rose, was delivered, and returned to bed without any of them being conscious of what had occurred. Cases like the last have often presented themselves in the English Courts.

Whether in any instance, the *drowning* of a child was accidental or criminal, must be a question for the jury to determine from all the facts laid before them. The situation in which the body of an infant is found, may plainly contradict the supposition of accident. On the other hand, a child may be accidentally drowned by its mouth falling into a pool of the discharges during delivery, although this would be rather a case of suffocation. The stomach of the child should always be examined on these occasions, as mud, sticks, straws, weeds, or other substances may be found, indicating, according to circumstances, that the child has been put into the water living, and that it has been drowned in a particular pond or vessel.

3. Cold.—A new-born child may be easily destroyed by simply exposing it uncovered or but slightly covered in a cold atmosphere. In a case of this kind, there may be no marks of violence on the body, or they may be slight and evidently of accidental origin. In death from cold, the only appearance occasionally met with, has been congestion of the brain with or without serous effusion in the ventricles. (See Cold.) The evidence, in these cases, must be purely circumstantial. The medical witness may have to consider, how far the situation in which the body was found,—the kind of exposure and the temperature of the air, would suffice to account for death from the alleged cause. There is no doubt that a new-born child is easily affected by a low temperature, and that warm clothing is required for the preservation of its life. An inspection of the body should never be omitted on these occasions; because it may turn out, that there was

some latent cause of death which would at once do away with the charge of murder. Admitting that the child died from cold, it becomes necessary to inquire whether the prisoner exposed it with the malicious intention that it should thus perish. Unless wilful malice be made out, the accused cannot be convicted of infanticide. In general, females do not expose their children for the purpose of destroying them, but for the purpose of abandoning them: hence it is rare to hear of convictions for child-murder, where cold was the cause of death, although some medical jurists have called this infanticide by omission, an offence which does not appear to be recognized by the English law. In the case of the *Queen v. Walters*, (Oxford Aut. Assizes, 1841,) it was proved that the prisoner, while travelling in a waggon, had suddenly left it, and that she was delivered of a child, which was afterwards found dead and exposed on the road. There was no doubt that the child had been born alive; for it was heard to cry after it was abandoned by its mother, who appeared to have carried it some distance after it was born. The child had died from exposure to cold. The woman was convicted of manslaughter, and sentenced to ten years transportation. For other medico-legal cases of death from cold, see Henke's Zeitschrift 1836, also 1840. i. 168, Erg. H.

4. Starvation.—A new-born child kept long without food will die, and no evidence of the fact may be derivable from an examination of the body. There may be no marks of violence externally, nor any pathological changes internally, to account for death. This is a rare form of committing murder, unless as it may be accidentally combined with exposure to cold. In order to convict the mother, it is necessary to show that the child was wilfully kept without food, with the criminal design of destroying it. Mere neglect or imprudence, will not make the case infanticide. The only appearance likely to be found on an examination of the body, would be complete emptiness of the alimentary canal. Without corroborative circumstantial evidence, this would not suffice to establish the cause of death. A medical witness could only form a probable conjecture on the point.

Among those cases of violent death, which leave on the body of the child, certain marks or appearances indicative of the cause, may be mentioned wounds, strangulation and poisoning.

5. Wounds.—Probably this is one of the most frequent causes of death in cases of infanticide. Wounds may, however, be found on the body of a child which has died from some other cause. The principal questions which a medical witness has to answer, are, 1, Whether the wounds were inflicted before or after death, or, to adopt the legal view of the matter, before or after the body of the child was *entirely* in the world in a living state: for according to the decisions of our judges, (antè, p. 468,) a child is not considered living in law, at least its destruction does not appear to be murder, until its body is entirely born. In most cases, it will be utterly impossible for a medical witness to return any answer to a question put in this form. All that medical evidence can pretend to show, is whether the child was

living or not when the wounds were produced :—for whether the *whole* of its body was or was not in the world at this time, they will possess precisely the same characters. In a few cases only, a conjectural opinion may be formed from the nature, extent and situation of these injuries ; 2, The witness will be required to state whether the wounds were inflicted before or after death ; 3, whether they were sufficient to account for death ; 4, whether they originated in accident or criminal design. All of these questions have been fully considered in treating the subject of WOUNDS ; and they therefore do not require any further notice in this place.

A case of infanticide was tried at the Buckingham Summer Assizes, 1840, (the *Queen v. Wood*,) where the main question was, whether five severe wounds found on the head of the child, were inflicted before or after death, and accidentally or criminally. The mother confessed, that the child was born alive, and had cried, but that it had died in five minutes after its birth. Its body was buried, and it was assumed that the wounds might have been inflicted after death by a spade which had been used for that purpose. The medical witness attributed death to the wounds, which, in his opinion, could not have been accidentally produced, but very properly admitted in cross-examination, that the wounds would have presented the same appearances, had they been inflicted immediately after death, while the blood was in a fluid state. Answers to questions of this kind, can of course be given only in those cases where the body is examined soon after the infliction of the wounds. It would be extremely hazardous to pronounce an opinion when the child has been long dead. In the case of the *Queen v. Taylor*, (York Lent Ass. 1843,) the child had been dead about a year, and when its body was found in a garret, it was so much dried up that the medical witnesses were unable, with certainty, to state the sex. The left arm had been removed from the body, and on the throat was a cut extending nearly from ear to ear, which was considered to have been made by some sharp instrument, and which, from the retraction of the edges of the wound, the witnesses thought must have been produced during life or immediately after death. The prisoner was acquitted. In this case there do not appear to have been any good medical reasons for the opinion expressed respecting the time at which the wound had been caused. Certainly, the retraction of the edges could furnish no evidence in a wound produced a year before. and in a subject so dried up as to render the recognition of the sex difficult. This may have been a case of child-murder, but there was no medical proof of it : it was not even proved that the child had come into the world living. Incised wounds found on the bodies of children, may be referred to the use of a knife or scissors by the prisoner, in attempting to sever the cord, and therefore be due to accident. This point should not be forgotten, for a wound even of a severe kind, might be thus accidentally inflicted. In such cases, we should always expect to find the cord cut and not lacerated. In the case of the *Queen* v. *Wales*, (Cent. Crim. Court, Sept. 1839,) it was proved that there was a wound on the right side of the neck of the child, not involving any important vessels, although it had caused death. The medical witness allowed, that it might have been accidentally inflicted in the way suggested, and the prisoner was acquitted. As this question may be unexpectedly put on a trial, a witness should prepare himself for it by a careful examination of the wound and of the umbilical cord. This will in general suffice to show, whether an incised wound has been produced accidentally in the manner alleged, or by criminal design.

Slight marks of external violence should not be overlooked :—minute punctures or incisions may correspond to deep-seated injury of vital organs. The spinal marrow is said to have been wounded by needles

or stilettoes, introduced between the vertebræ, the skin having been drawn down before the wound was inflicted, in order to give it a valvular character, and render it apparently superficial. The brain is also said to have been wounded by similar weapons, through the cribriform plate of the ethmoid bone or the fontanelles.

The only injuries which require to be specially considered in relation to infanticide, are *fractures of the skull*, and here the question to which we may restrict our examination, is whether the fracture arose from accident or criminal violence. Although it has been a matter of frequent observation, that great violence may be done to the head of a child during parturition, without necessarily giving rise to fracture; yet it is placed beyond all doubt, that this injury may occur by the expulsive efforts of the uterus forcing the head of a child against the bones of the pelvis. Even the violent compression which the head sometimes experiences in passing the os uteri, may suffice for the production of fracture. (See Ed. M. and. S. J. xxvi. 75.) Until within the last few years, it had been generally supposed that fractures of the cranium in new-born children, were always indicative of violence; but the cases collected by Dr. Schwörer, of Freiburg and others, establish the possibility of their accidental occurrence. These accidental fractures, it is to be observed, are generally slight;—they commonly amount merely to fissures in the bones, beginning at the sutures and extending downwards for about an inch or less into the body of the bone.

The following case occurred to Dr. Schwörer while performing his duties at the Obstetric Institution. The child was still-born; he received it into his hands at birth, so that the head could have sustained no outward violence. On inspection, the skin over the vertex was found swollen; and on removing it, there was a large extravasation of blood beneath, especially over the right parietal bone. The bone was fractured or fissured in two places. Blood in a half coagulated state, was found beneath the fissures, between the bone and the dura mater, as also between this and the tunica arachnoides. (Beit. zur. Lehr. v. d. Kindermord. Freiburg, 1836.) Here then were all the signs indicative of external violence; and possibly, had this woman been delivered in secret, and the body of the child found in a concealed place, she might have been charged with the murder. Another case is reported in Casper's Wochenschrift, (Oct. 1840,) where about half a drachm of blood was extravasated on the right parietal bone, which was compressed in the centre and presented a radiated fracture. Coagula were found on the dura mater. (See also B. and F. Med. Rev. xxi. 254, and vii. 233.) In another case, where there was deformity of the pelvis, the child was born dead, and there were two fissures about an inch long in the left parietal bone; and both parietal bones were considerably flattened. (Casper's Wochenschrift, Sept. 1837.)

In respect to these accidental fractures and extravasations, it may be remarked that they are in general recognized by their very slight extent. In cases of murder by violence to the head, the injuries are commonly much more severe: the bones are driven in,—the brain protrudes, and the scalp is extensively lacerated. Such extensive injuries as these, cannot arise accidentally during parturition from the action of the uterus. In these cases, however, it may be fairly urged,

that the woman was unexpectedly seized with labour, that the child was expelled suddenly by the violent efforts of the uterus, and that the injuries might have arisen from its head coming in contact with some hard surface, as a floor or pavement. It must be admitted, that a woman may be thus suddenly and unexpectedly delivered while in the erect posture, although this is not common among primiparous females; and that injuries may be thus produced on the head of a child. An interesting case of sudden delivery in the erect posture in a primiparous female, without injury to the child, is reported by Mr. Ryan in the Lancet, June 21, 1845. p. 707. If we are to judge from the cases collected by Dr. Klein, fractures of the cranium under these circumstances, must be of very rare occurrence. Out of one hundred and eighty-three cases reported by him, in which the women were rapidly delivered while sitting, standing, or inclined on the knees,—the child falling on the ground or floor, there was only one instance in which the child was killed; and there was not a single case in which the bones of the cranium were fissured or fractured, so far as could be ascertained by external examination. (Devergie, i. 631. Briand, 271.) Chaussier performed some experiments on the bodies of still-born children, allowing them to fall with their heads downwards on a paved floor from a height of eighteen inches; and he found that out of fifteen cases one or other of the parietal bones, was fractured in twelve. Although these results are conflicting, yet Klein's observations appear more to the purpose; because they were made under circumstances in which the question would really arise in a case of infanticide. They are strikingly supported by a case which occurred to Mr. Blacklock. (Lancet, July 26. 1845.) A married woman was suddenly delivered while standing:—the child fell to the floor, but sustained no injury. The umbilical cord was ruptured close to the umbilicus. (See also Mr. Ryan's case, Lancet, June 21, 1845, 706.) These observations would lead to the inference that such accidents are not likely to occur, yet we cannot deny the *possibility* of their occurrence; therefore a barrister is fully justified in endeavouring to exculpate a person charged with child-murder upon this ground. A medical witness would find no difficulty in determining the probability of this explanation of the origin of the fractures, if he were made acquainted with all the facts connected with the delivery. But the acquisition of this knowledge must be accidental; and it will in general be out of his power to obtain it. Sometimes the fractures will be accompanied by incisions, punctures, or lacerations of the scalp or face:—in this case, however the origin of the fractures might be accounted for by the alleged fall during parturition, the cause of the other injuries would still remain to be explained.—(See the case of the *Queen v. Reeve*, Cent. Crim. Court, Feb. 1839. The *Queen v. Stevens*, Bodmin Lent Ass. 1845.) The report of a very interesting trial, in which this question respecting the accidental origin of fractures arose, will be found in the Med. Gaz. xviii. 44. The case was tried before the Criminal Court of New York in November, 1834. One of the medical witnesses posi-

tively denied that the bones of the cranium could be fractured by the action of the uterus during parturition! It appeared highly probable that the fractures had been here occasioned by the accidental fall of the child during delivery—and the prisoner was acquitted.

It has been recommended on these occasions, that we should observe the length of the umbilical cord, and notice whether it be cut or lacerated, as these facts may, it is presumed, throw some light on the question. But a medical witness can seldom procure the cord for examination, although it will generally be in his power to ascertain whether it was cut or lacerated by examining that portion attached to the body of the child. The cord varies in length,—the average being from eighteen to twenty inches; but it has been met with so short as seven and a half inches, and in one instance, where it was found twice twisted round the child's neck, it was fifty-three inches long. Dr. Churchill found, out of three hundred and ninety-one cases, that the shortest cord was twelve inches, and the longest fifty-four inches in length. As the whole of the cord can rarely be obtained, it is unnecessary to discuss the question, whether it were long enough to admit of the falling of the child without rupture. It has been remarked that when the cord is ruptured from accidental causes during delivery, the rupture takes place either very near its placental or umbilical end. In twenty-one of the cases observed by Klein, it was found to have been forcibly torn out of the abdomen; but it may be torn or lacerated at any part of its length, although the rupture is commonly observed to occur near one or the other extremity. It does not appear how the examination of the cord can throw any light upon the origin of these fractures of the cranium.

Children are sometimes destroyed in the act of birth by the neck being forcibly twisted, whereby a displacement of the cervical vertebræ, with injury to the spinal marrow, may occur and destroy life. Such injuries are immediately discovered by an examination. It should be remembered however that the neck of a child is very short, and that it always possesses considerable mobility.

When the marks of violence found on the head, neck and body of a child, cannot be easily referred to an accidental fall, it is very common to ascribe them to the efforts made by the woman in her attempts at *self-delivery*, and without any intention on her part of destroying life. The rules to guide a medical opinion in such a case, must depend upon the nature, situation and extent of the injuries; and each case must be therefore decided by the circumstances attending it. (The *Queen* v. *Horder*, Abingdon Summer Ass. 1840.) This should be contrasted with two other cases (the *Queen* v. *Trilloe*, Hereford Summer Ass. 1842; *Queen* v. *Turner*, Worcester Winter Ass. 1843.) In the two first cases, the children were admitted to have been living;—in the one the violence was chiefly confined to the head, and the prisoner was acquitted,—in the other the marks of violence were upon the neck, and the prisoner was convicted. These cases show the uncertainty attendant on a plea of this kind.—(See also two other instances, B. and

F. Med. Rev. viii. 521.) Sanguineous tumors simulating fractures are sometimes found on the heads of new-born children. These depend on natural causes, and must not be confounded with marks of violence. (Med. Gaz. xxxvi, 1082.) They may be known by the unruffled state of the skin. A medical witness, however, must be prepared to allow that a woman at the time of her delivery, may from pain and anxiety become deprived of all judgment, and may destroy her offspring without being conscious of what she is doing. It is therefore a sound principle of law that mere appearances of violence on the child's body are not *per se* sufficient, unless there be some evidence to show, that the violence was knowingly and intentionally committed, or they are of such a kind as themselves to indicate intentional murder. (Alison.) The benefit of a doubt will always be given in favour of the accused. See PUERPERAL MANIA, post.

CHAPTER XLV.

DEATH OF THE CHILD FROM VIOLENT CAUSES—WHETHER THE VIOLENCE WAS OF ACCIDENTAL OR CRIMINAL ORIGIN.

6. STRANGULATION.—The destruction of a new-born child by strangulation, is not an unfrequent form of child-murder; and here a medical jurist has to encounter the difficulty,—that the strangulation may have been accidentally produced by the twisting of the umbilical cord round the neck during delivery.

We must not hastily conclude from the red and swollen appearance of the face and head of a child, when found dead, that it has been destroyed by strangulation. There is no doubt that errors were formerly made with respect to this appearance; for Dr. Hunter observes, "When a child's head or face looks swollen, and is very red or black, the vulgar, because hanged people look so, are apt to conclude that it must have been strangled. But those who are in the practice of midwifery, know that there is nothing more common in natural births, and that the swelling and deep colour go gradually off if the child live but a few days. This appearance is particularly observable in those cases, where the navel-string happens to gird the child's neck, and where its head happens to be born some time before its body."—(Op. cit. 27.) Strangulation by the umbilical cord can of course refer to those cases only in which the cord becomes firmly twisted round the neck after the respiratory process is established; and this is rather a rare occurrence,—as death more commonly takes place by compression of the cord under these circumstances, and the consequent arrest of circulation before the act of breathing is performed. (See antè, p. 476.) The appearance of ecchymosis on the scalp, and lividity of the face, is very common in new-born children when the labour has been difficult; and

therefore unless there were some marks of injury about the neck, this would not justify any suspicion of death from strangulation. The only internal appearance is a congested state of the cerebral vessels.

It has been supposed, that the strangulation produced by the wilful application of any constricting force to the neck, would be known from the accidental strangulation caused by the cord, by the fact that in the former case, there would be a livid or ecchymosed mark or depression on the neck. But in answer to this view, it may be observed, that such a mark, although, from the unnecessary violence used, a common, is not a constant accompaniment of homicidal strangulation. On the other hand, although it was formerly a disputed question, it is now certain that the umbilical cord may itself produce a livid or ecchymosed depression. By trusting to this mark as an absolute means of diagnosis, therefore, an innocent woman may be unjustly condemned. A case is reported in the Annales d'Hyg. 1842, 127, which involved this question.

A woman was charged with the murder of her child by strangulation. The child had fully and perfectly respired:—the lungs weighed one thousand grains, and when divided every portion floated on water, even after firm compression. There was a mark on the neck, which was superficially ecchymosed in a part of its course. From an investigation of the facts, this appeared to have been a case in which the mark was produced accidentally by the umbilical cord during attempts at self-delivery on the part of the woman. She was nevertheless convicted and condemned to a severe punishment. This case establishes three points: 1, that partial ecchymosis may be produced on the neck by the umbilical cord becoming twisted around it; 2, that this may strangle a child after it has breathed at the outlet,—the cord was twenty-four inches long; 3, that a child's lungs may in a few seconds become sufficiently distended with air to give satisfactory evidence of respiration with the pulmonary tests. See p. 459. In the same journal, p. 428, will be found the report of another case, suggesting many important reflections in regard to the medical jurisprudence of infanticide. In this case the umbilical cord and membranes were actually used by the female as the means of strangulation; the child had not breathed, but was thereby prevented from respiring. There was superficial ecchymosis on each side of the neck over the sterno-cleido-mastoidei. The defence was, that the child was born with the cord round its neck, and that it was accidentally strangled; but the medical evidence tended to show, that the cord had been violently stretched and used as a means of strangulation. The child had not breathed, and the witnesses considered it to have been born dead, owing to the violence used by the woman. The cause of death here was certainly not strangulation, but arrested circulation. In the mean time, the case proves that ecchymosis may be the result of the constriction produced by the cord. For additional remarks on this subject see Henke's Zeitschrift, 1837, iv. 352; also Ed. M. and S. J. Oct. 1838, p. 282. A case occurred to Mr. M'Cann, in September 1838, in which the umbilical cord, which was of its full length, had been used as the means of strangulation. It was twisted once round the neck, passed under the left arm over the shoulders, and round the neck again, forming a noose or knot, which pressing upon the throat must have caused strangulation, as the tongue was protruded, and there were other clear indications of the child having been strangled. The hydrostatic test applied to the lungs proved that the child had respired.

When the mark is deep and much ecchymosed, with extravasation of blood beneath, and ruffling or laceration of the skin, it is impossible

to attribute this to the effect of the umbilical cord. The lividity produced by the cord in the cases hitherto observed, has been only slight and partial, and unaccompanied by laceration of the skin, or injury to deep-seated parts. For a very instructive case by Dr. Scott, in reference to this point, see Ed. M. and S. J. xxvi. 62. On the other hand, in homicidal strangulation, much more violence being used than is necessary for destroying life, we should commonly expect to find great ecchymosis and extensive injury to the surrounding soft parts. On some occasions, all difficulty is removed by the discovery of the rope, tape, or ligature round the neck; or if this be not found, the proofs of some ligature having been used, will be discovered in the indentations or irregularly ecchymosed spots left on the skin, the depressed portions of skin being generally white and the raised edges livid. Marks on the neck may be produced by the umbilical cord without necessarily destroying the child's life; two cases of this kind are reported by Professor Busch: (B. and F. Med. Rev. x. 579;) or the child may be destroyed without ecchymosis being a necessary consequence of the constriction produced by it. For another case by Dr. Hanff, see Henke's Zeitschrift, 1836, Erg. H. There is much less risk from twisting of the cord, than is commonly believed. Out of one hundred and ninety cases, Dr. Churchill found the cord round the neck in fifty-two. The shortest cord so disposed, was eighteen inches long, and it occurred twice in seventy-five cases.

In the fore part of the neck of a child, a mark or depression, is sometimes accidentally produced by forcibly bending the head forwards on the chest, especially when this has been done repeatedly and recently after death. It may happen also during labour. Such a mark must not be mistaken for the effect of homicidal violence. It has been a question whether, independently of the constriction produced by the cord,—the cervix uteri might not cause, during its contractions, an ecchymosed mark on the neck. I am not aware that there is any case reported which bears out this view. It seems highly improbable that any such result should follow. The mark on the neck is sometimes such as not to be explained by the supposed accidental constriction of the umbilical cord. The ecchymosis may be in detached spots or patches,—situated in the fore part of the neck, and evidently not arising from the application of any ligature. These marks may depend on the forcible application of the fingers to the fore part of the neck of the child, and the indentations have been known to correspond,—a fact which at once led to a suspicion of the mode of death. It may be alleged in defence, that the marks might have been accidentally caused in two ways: 1. By the forcible pressure produced by the child's hand during labour, an explanation which is highly improbable if respiration have been performed:—although a child has been known to breathe in breech presentations, while the head was still in the vagina. 2. They will be more commonly referred to the violent attempt made by a woman at self-delivery, during a paroxysm of pain. This explanation is admissible, so long as it is confined to injuries

probably received during labour; but supposing the marks to have been certainly produced after birth, it will not of course apply. The following case (the *Queen* v. *Ancliffe,* Nottingham Lent Assizes, 1842) is in this respect worthy of attention; for it appears to me, to show how a defence of this kind may be sometimes strained:

The evidence proved that the prisoner was delivered of a child, under much suffering, on a stone floor, and in the presence of another woman,—a witness. The child was born alive, and was heard to cry several times. The witness left it in charge of its mother, and on returning shortly afterwards, she found it dead with black marks upon its throat. The female midwife, who separated the child from the mother, deposed that it gave a sort of half cry;—she thought it was dead when she first saw it, and the marks on the neck were not more than a woman might have caused in attempting to deliver herself. The medical evidence showed that there were many ecchymosed marks about the throat of the child; and on the right side of the neck, blood was extravasated. The marks might have been produced by the fingers:—death had been caused by pressure on the windpipe. The judge left it to the jury to say, whether the marks of violence might not have been unconsciously inflicted by the prisoner during labour. The jury returned a verdict of acquittal. (See also a case by Bellot, Ann. D'Hyg. 1832, ii. 205.)

A medical witness is sometimes asked to state on these occasions, whether the ligature or the fingers had been applied to the neck of the child, before or after death,—or before or after it had breathed. It is proper to observe, that so far as the external marks of strangulation are concerned, there is no difference in the appearances, whether the constriction take place during life or immediately after death while the body is warm. Casper's experiments render it highly probable, that when the constricting force is applied to the neck of a dead child at any time within an hour after death, the marks cannot be distinguished by any appearance from those made on a living body. (Wochenschrift, Jan. 1837.) With regard to the second point, it may be stated, that whether the child has breathed or not, provided it be living, the marks of violence present precisely the same characters. The following case is related by Casper.

The body of a new-born child was found concealed in a cellar, and the mother was charged with having murdered it. She confessed that she heard the child cry at the birth, but that it soon died. In about an hour afterwards, she tied tightly round its neck, a band made of a few straws, which she had hastily twisted together for that purpose, in order, as she alleged, "to prevent it from awaking." On the fifth day, the body was examined; the child was mature, well-formed, and had evidently breathed. The examiners referred death to strangulation:—the woman was convicted and sentenced to be imprisoned for life. An appeal was made against this sentence, and Casper's opinion was called for on the propriety of the medical inference of strangulation during life from the mark on the neck. The witnesses had stated;—"that each straw in the band had produced a well-defined depression, which was whiter than the surrounding skin, while the little folds or elevations between the straws were red;—and on cutting into these reddened portions, slight ecchymosis was found beneath." Casper gave his opinion, that the slight ecchymosis observed, might have resulted from the application of the straw-band soon after death,—while the body was warm; and the circumstantial evidence allowed, that the ligature might have been applied at some

time within an hour after death. Hence he declared, that there was a want of proof that this child had died from strangulation. In consequence of this opinion the punishment was mitigated. It is impossible to deny the correctness of the inference drawn by Casper, since the mark was undoubtedly such, that it might have been produced either before or after death. Which of these two suppositions was the more probable; and whether it was more likely, that a ligature should be put round a child's neck an hour after death to prevent it from awaking (!) or before death for the alleged purpose of destroying it, it was of course for a jury, and not for a medical witness to decide. If there was nothing more in the prisoner's favour, than her own statement, as to the time when she applied the ligature and her object in applying it, it is certain that a very humane interpretation was put upon the facts. If the Court entirely believed Casper's opinion, the woman should have been altogether acquitted, instead of having the punishment merely mitigated. It can be no crime, however absurd and unaccountable it may appear, for a person to place a ligature round the neck of a child after death, to give the appearance of strangulation. When such an extraordinary plea as this is raised, it is a fair matter of inquiry for a jury, to consider the motives of human conduct, and to judge of such a defence on the principles of common sense. If carried too far, no one could be convicted of homicidal strangulation, who was not seen by others to perpetrate the act. In the case of the *Queen* v. *Wren*, tried at the Winchester Lent Ass. 1840, the medical evidence went to show that the child had breathed, and was born alive. There was a piece of tape tied round its neck very tightly, and fastened behind, and there was a discoloration of the skin beneath. The tongue was livid and swollen, and blood was extravasated beneath the scalp. The medical witness admitted that the mark on the neck might have been produced after death; and as he could not positively say that the child had been destroyed by strangulation, the prisoner was acquitted. (See also the *Queen* v. *Hyland*, Cent. Crim. Court, Aug. 1844.)

Judging from what has occurred on several recent trials, a medical witness must prepare himself for another and more difficult question. Let us suppose it to be admitted as proved, that the ligature was applied to the neck of a child while it was living, and after it had breathed;—it still remains to be determined, whether it was applied before or after the legal birth of the child, or as some judges have laid down the rule, before or after an independent circulation has been established in the child's body. In the case of *R.* v. *Enoch*, Judge Parke held "that there must be an independent circulation in the child before it can be accounted alive." (Archbold, 367.) By an "independent circulation," we can only understand that condition in which respiration is established, and the blood no longer passes from the mother to the child. Thus, this state would be proved by a cessation of pulsation in the cord; and the crying or audible respiration of the child. It will be seen that this is tantamount to insisting upon absolute proof of respiration, as evidence of life; and, therefore, entirely conflicts with the opinions of many other judges, who have held that proof of respiration is not necessary on a charge of murder, because a child might be born alive and not breathe for some time after its birth. (*R.* v. *Brain*. Archbold, 367. See antè, p. 438.) If the presence of an independent circulation be the test of a child being legally alive at the time of the violence, the entire birth of its body is certainly not necessary for this; because, as it is well known, respiration may be

established, and consequently an independent circulation acquired, before the body of the child is *entirely born*. Here again, this judgment is opposed to the opinions of most judges, who have repeatedly held that whether a child has breathed or not, entire live birth must be proved. One of the most common judicial objections to the hydrostatic test, is, that a child may breathe, i. e. substantially acquire an independent circulation, but die before its body is born. In this state of uncertainty, it is very difficult to say *what*, medical evidence is required to prove. If an independent circulation alone is sufficient, it cannot be always necessary to prove entire live birth; but if proof of entire live birth be sufficient, then it cannot be always necessary to show that the child had acquired an independent circulation when the violence was offered to it! In a celebrated case of tenancy by courtesy, (*Fish* v. *Palmer*, 1806, post, BIRTH,) the judges of that time held that the quivering or spasmodic motion of a lip after birth without respiration, independent circulation, or any other sign of vitality, was sufficient to show that that child was born alive—and that it thereby had acquired civil rights which it could transmit to others,—its heirs. Why is the proof of an independent circulation in a child, to be demanded of medical witnesses in a case involving a question of its murder; when in respect to its acquisition of civil rights such a proof is not called for? If the question were fairly considered by all the judges, probably proof of an independent circulation would not be required, at any rate it could not be consistently demanded in the face of other decisions given, that proof of respiration was not absolutely necessary to constitute live birth in law, even in cases of child-murder. The last case in which this question was raised, was on the Oxford Spring Circuit, 1841, (the *Queen* v. *Wright*). The child was found concealed in a garden, its throat was completely cut, and there was a stab under the left arm. Baron Gurney is reported to have stopped the case; because there was no proof that the child had had "an independent existence" when the wounds were inflicted. It is worthy of remark, that one form of murder may be the actual prevention of the establishment of an independent circulation or existence in the child, as where the cord is designedly tied before the commencement of the respiratory process. It has been suggested that ignorance of this point, among midwives, may be a cause of numerous still-births.

In the mean time one fact is obvious, that whether the means of strangulation, if that be the form of murder, be applied to the neck of a living child before the entire birth of its body or afterwards,—before the establishment of an independent circulation (i. e. the act of respiration) or afterwards,—the appearances will be the same; and from these, it will be impossible to say, when the strangulation was accomplished. There is still another novel form which this question has taken. The witness may perhaps be asked, whether the strangulation occurred before or after the umbilical cord was severed. It would appear that the severance of the cord has been regarded as the test of an independent circulation being established in the child:—but this is obviously

an error depending on the want of proper information respecting the phenomena which accompany birth. Respiration, and therefore an independent circulation, may exist before the cord is divided, and its severance, which is never likely to take place until after entire birth, cannot consequently be considered as a boundary between a child which is really born alive, and one which is born dead. A premature severance, as it was just now stated, might positively endanger the life of the child, instead of giving to it an independent existence. A healthy and vigorous child may continue to live and breathe independently of the mother, before the division of the cord, and the time at which the severance is made, depends on mere accident. Hence the marks of strangulation on the neck of a living and breathing child, must be the same, whether the cord be divided or not. The object of putting such a question is not apparent, unless it is intended to be implied, that no child is legally born alive until the accoucheur or the woman herself chooses to sever the cord. It would therefore follow on this doctrine, that to strangle a living child (entirely born) with the umbilical cord, provided this be not lacerated in the attempt, would not constitute infanticide! If this inference be incorrect, it is impossible to see what can have been the object of asking a medical witness such a question on these occasions. The following cases will illustrate the difficulties which a witness may have to encounter.

The first is that of *Rex* v. *Crutchley*, (Monmouth Lent Assizes, 1837). In this case the body of the child was discovered by a medical man (one of the witnesses) under the bed of the prisoner, who had been secretly delivered of it. There was a riband tied so tightly round its neck in a knot, as to have prevented respiration. The child had evidently been dead some hours, and the prisoner alleged that it was born dead. On inspection the face was found swollen and the lips livid, the lungs contained air and were of a florid colour; they were crepitant and floated on water, so as to leave no doubt that the child had breathed. The vessels of the brain were gorged; the other viscera perfectly healthy. He attributed death to strangulation;—he thought that the ligature had been placed round the neck before the umbilical cord, which had not been tied, was secured; but the reason for this opinion is not stated. He considered that the child had been born *wholly* alive; but admitted that the ligature would have produced the same appearance on the neck, had it been applied before the complete birth of the child. Another witness, however, stated that he thought the ligature might have been placed round the neck before the entire body of the child was born. The defence was, that the ligature had been used by the woman for the purpose of assisting herself in the labour, and that the medical evidence allowed, whether this was the motive or not, that it had been applied before the child was actually born. The judge desired the jury to consider, whether the prisoner wilfully killed the child,—if so, whether the killing occurred before or after the entire birth of its body,—and lastly, whether the killing took place while it was still attached to the body of its mother Unless the child was destroyed after entire birth, the prisoner would be entitled to an acquittal:—if destroyed, while still attached to the body of its mother, the point would be reserved for the consideration of the judges. The prisoner was acquitted. There can be no doubt that, provided a child be born entirely in a living state, the destruction of it would be murder, whether the cord were severed or not. In the case of the *Queen* v. *Byron*, (Chester Aut. Ass. 1838,) the dead body of the child was found with a piece of rag tied round its neck, which in the opinion of the medical witness had caused death by strangulation; but on cross-examination by the judges, he

admitted that the appearances might be explained by supposing that the prisoner had produced them in attempting to deliver herself. In the case of the *Queen* v. *Millgate*, (Central Criminal Court, Nov. 1842,) the child was discovered dead, and on examination the face was livid, the tongue protruded, and the hands were clenched. Around the neck was a ligature which had been passed round four times, and was tied tightly. The vessels of the brain were turgid, the lungs partially inflated, and the general appearance of the body was healthy. The medical witness thought that the child had been born alive, and had died from the effects of the ligature on the neck. The judge told the jury they must be satisfied that the child was completely born at the time the ligature was put round the neck. The prisoner was acquitted. In another case, the *Queen* v. *Webster*, (Worcester Lent Ass. 1839,) the following facts were deposed to by the surgeon. The child was full-grown and was born alive:—this was inferred from the lungs being completely inflated. A ligature was found round the neck—it had been passed round twice—was very tight, and fastened in a knot:—it had caused two deep indentations. The vessels of the scalp and brain were turgid with blood, but there were no marks of external violence. Death was caused by strangulation. The judge left it to the jury to say, whether they were satisfied that the child was wholly born into the world alive; and if so, whether the prisoner had knowingly and wilfully destroyed it after it was born. The prisoner was acquitted.

It may be an important question whether, in these instances, the absence of any mark or discoloration of the skin by the ligature, should be taken as evidence of the means of constriction not having been applied during life. What we are entitled to say from observed facts, is, that ecchymosis from the ligature, is not a necessary consequence of constriction either in a living or dead child:—although we might expect that there would be few cases of child-murder in which, when strangulation was resorted to, there would not be some ecchymosed mark or discoloration, chiefly on the presumption, that great force is suddenly applied. Besides, it is not improbable that slighter force would cause ecchymosis on the skin of a new-born infant, than would be required to produce such an effect on that of the adult. When there is no mark from the ligature, an attempt may be made to show, that death could not have been caused by strangulation, as in the following case, (the *Queen* v. *Hagg*,) which was tried at the Carlisle Summer Ass. in 1841.

The medical evidence was to this effect. The deceased child was discovered with a tape tied tightly round its neck. It was full-grown and healthy, and had been born alive, as respiration had been fully established. The lungs filled the chest, floated on water, and crepitated when pressed. From the livid appearance of the face and neck;—the congested state of the brain and extravasation of blood on the surface, combined with the ligature round the neck, the witnesses were of opinion that the child had died from strangulation. On cross-examination, they said that a child may breathe when partially born. The floating of the lungs in water is of itself an uncertain test, if the body is at all decomposed. With other tests it affords a proof of a child having been born alive. One witness said, the ligature had produced no mark of discoloration on the neck, while others said it was perceptible. The inference is, that the mark could not have been very apparent, or there would have been no doubt on this point. It was ingeniously urged in the defence, that the child could not have died from strangulation; because a tape tied so tightly round a child's neck as to cause death in this way, would leave a

discoloration, of which no person could have any doubt. The prisoners were convicted. Had the defence been, as in the former cases, that there was no proof whether the ligature had been applied before or after entire birth, or the establishment of an independent existence in the child, the result might have been different. From the cross-examination, it will be seen, in what way the objections to the hydrostatic test are ingeniously made to affect medical evidence. An answer to a *general* question is rendered applicable to a *particular* case. A witness admits on a trial that the lungs may float from putrefaction or artificial inflation:—in short, from other causes than respiration. If this answer be not qualified, an impression is immediately conveyed to the Court, and not always removed by a re-examination, that some of those causes may have given rise to the floating of the lungs in this particular instance,—when in fact there may have been not the least trace of putrefaction,—nor the least ground for suspecting that artificial inflation had been practised. As contrasts to this case, see report of a case which occurred to Mr. Coales. G. H. Rep. April 1842; and another by Dr. Scott, Ed. Med. and Surg. J. xxvi. 62.

Poisoning.—This is placed among the probable means of perpetrating child-murder, but we rarely hear of new-born children being thus destroyed. The earliest age at which I have known a trial to take place, for the murder of a child by poison, was two months. (*R.* v. *South*, Norf. Aut. Circ. 1834.) A quantity of arsenic was given to an infant, and it died in three hours and a quarter after the administration of the poison. At this age, the case can scarcely be called one of infanticide in its medico-legal signification; because all that it would be necessary to prove would be the cause of death,—the question of life or live-birth would not require to be entered into. If poison should be suspected it must be sought for in the usual way. (See antè, p. 15.)

The duties of a medical witness, as they relate to the *mother* of the child, generally the accused party, are slight. All that he is required to do, is to show, by an examination made under an order from proper authority, whether or not she had been recently delivered of a child, and to state the probable period at which the delivery took place. (See post, Delivery.) This examination may be necessary in order to connect her delivery with the period which may have elapsed since the birth and death of the child. Unless the examination of the female be made within twelve or fifteen days, no satisfactory evidence of delivery, can in general be obtained. It has happened on more than one occasion, that medical men have assumed to themselves the right of enforcing an examination of a suspected female, and by threats or otherwise, have compelled her to undergo this. Such a course of conduct is in the highest degree indecent and improper:—if a female willingly consents to the examination, or an order be obtained from a magistrate or other official person, the case is different. In taking this authority upon himself, a medical practitioner is forcibly compelling an accused party to produce positive proofs of her guilt, a principle which is entirely opposed to the spirit of English jurisprudence!

From the foregoing considerations it will be seen, that the two great

points to be established by medical evidence, in a case of child-murder, are, 1st, that the child was *entirely born living* when the alleged violence was applied to it; and 2nd, that its death was due *to that violence, and to no other cause whatever.* The leniency with which such cases are regarded by the law, and the extreme rigour with which the medical evidence, either of live-birth or the cause of death, is treated, must show that they who consider that the use of the hydrostatic test can ever lead to the conviction of an innocent woman, have taken a very limited and incorrect view of the subject. The question of murder rests here, as in all other cases, upon clear and undoubted proof of the cause of death:—and more than this, it must be shown that the violence was criminal, and not by any possibility accidental. Then it should be proved that this violence, if criminal, must have been applied to the body of a child at a particular period, i. e. after entire birth, a case which, from what has already been stated, can rarely admit of clear medical proof. If strangulation, for example, be rendered probable from the facts,—the woman cannot be convicted, unless proof be afforded, 1st, that the child was strangled after its entire body was born; and 2nd, that she could not possibly have produced the marks of strangulation in her convulsive or half-conscious attempts at self-delivery. Medical evidence can rarely be in a condition to establish either of these points, and the assumptions will therefore be, as in the many cases already reported, in favour of the prisoner. A question will probably here suggest itself from the number of *impossible* proofs, so to term them, which the law requires in these cases, namely—How can a conviction for child-murder ever take place where there are no eye-witnesses to the crime? The answer is, that these difficulties may not be raised in the prisoner's favour; but this of course is a matter of accident. On most charges of infanticide, if the counsel for the defence insisted upon distinct medical proof of the child having been *entirely born alive,* when the violence was offered to it:—or that respiration, if clearly established by evidence, took place, not during labour, but after complete birth, or after the child had acquired an independent circulation;—neither of these proofs could be possibly afforded; and the case, so far as medical evidence was concerned, would fall to the ground. The frequent acquittals on these charges, most probably depend on the fact, that there are many extenuating circumstances in the prisoner's favour. She may be young, unfortunate, friendless and perhaps tempted by a seducer, or by utter destitution, to the perpetration of the crime. According to the present state of our law, the jury have no alternative, but to convict her of a capital offence, or acquit her of the charge of murder, and find her guilty of the concealment of birth, the extreme punishment for which is two years' imprisonment. This is substantially the punishment at present admitted for the crime of infanticide in this country; for it is not to be concealed that *medically* speaking these technical points relative to "live-birth," to "entire birth," or to an "independent circulation in the child;" or lastly, "concealed birth," are only so many ingenious means for evading convictions on the

capital charge. Whatever doubt may exist according to the forms and principles of law, there can be no doubt medically, that living children are often criminally destroyed; and that the law, from the extreme severity of the punishment attached to the crime, cannot reach the perpetrators. In most of these cases the punishment of death would be as much too severe, as the punishment of two years' imprisonment for "concealed birth" is too slight; and with a full contemplation of this difficulty, the Civil code of France (Art. 319) wisely permits the Court, on proof of extenuating circumstances, to mitigate the punishment. Some such provision is required in our law, and the unnecessary perplexities which are now thrown on medical evidence, as well as the conflicting opinions on what is live-birth and what is not, would then disappear. A change of this kind might undoubtedly be made without prejudice to the innocent.

It is a question which it would be here out of place to discuss, whether a verdict of manslaughter might not be proper on many of these occasions; for to say that the whole offence consists in concealing the birth of a still-born child, is virtually to disbelieve and reject the clear and satisfactory medical evidence often adduced. (See cases antè, the *Queen* v. *Mortiboys*, p. 479.) A verdict of manslaughter would not, however, cover those numerous cases where it is *assumed* that the child only lived to respire in the act of birth, and not afterwards. Dr. Christison, in commenting upon the frequent acquittals on the capital charge, and convictions only on a minor offence which cannot always be proved, attributes it to a feeling sometimes entertained in the present day, that the killing of a new-born child, when perpetrated under the impulse of injured honour and the fear of disgrace, should not be classed with the other varieties of murder. (See Ed. M. and S. J., xxvi. 76.) There can, I think, be no doubt that this is the true explanation. (See also case by Mr. Coales, G. H. Rep., April, 1842.)

I may mention in concluding this subject, as the point has given rise to a trial for malapraxis, that if injuries should be criminally inflicted on a child during birth, and the child be born alive and afterwards die from the injuries so caused, the case would be murder or manslaughter, according to the circumstances. The following instance is reported by Chitty. (Med. Jur. 416; also Archbold, 345.)

A man of the name of *Senior* who, it appears, was an unlicensed medical practitioner, was tried, in 1832, for the manslaughter of an infant by injuries inflicted on it at it birth. The prisoner practised midwifery, and was called to attend the prosecutrix who was taken in labour. The evidence showed, that when the head of the child presented, the prisoner by some mismanagement fractured and otherwise so injured the cranium that it died immediately after it was born. It was argued in defence, that as the child was not born (*in ventre sa mere*) at the time the wounds and injuries were inflicted, the prisoner could not be guilty of manslaughter. The judge, however, held that as the child was born *alive* and died, the case might be one of manslaughter. This opinion was afterwards confirmed by the other judges, and the prisoner was convicted and sentenced to imprisonment. From the decision in this case, it will be seen that the law makes the question of criminality to depend upon the period at which the injuries prove fatal, and not upon the period at

which they are inflicted on the body of a child. The distinction appears to depend on this principle of the criminal law, that the person killed, must be a reasonable creature in being and under the king's peace:—therefore to kill a child in its mother's womb is no murder. (Archbold, 345.) The child, unless born alive, does not come under the description above given. Admitting the wisdom of adopting some fixed rule of this kind in a legal view, it is undoubtedly proper that the lives of children in the act of birth should be protected;—at any rate, that their destruction should not be treated, as it now appears to be, with perfect impunity.

It is difficult to determine the number of cases of infanticide which take place annually in this country. But in France, where criminal statistics are more closely attended to, there were, in 1838, one hundred and twenty-nine cases, and in 1841, one hundred and forty-seven cases. (See also Annales D'Hygiène, Oct. 1840.)

PREGNANCY. DELIVERY.

CHAPTER XLVI.

SIGNS OF PREGNANCY. LEGAL RELATIONS. DELIVERY IN THE LIVING AND DEAD.

Pregnancy.—The subject of pregnancy, in so far as the proofs of this condition in the *living* female are concerned, very rarely demands the attention of a medical jurist. Some exception has been taken to this opinion, but having now during fifteen years collected many hundreds of cases, which have been the subject of inquisition or trial in England and Wales, I am enabled to say that there are not more than five in the whole collection, in which the signs of pregnancy became a matter of evidence; and in some of these, the fact of pregnancy was actually referred to the decision of a jury of women and not to a medical man! In relation to medical practice or to midwifery, the subject is undoubtedly one, the importance of which cannot be overrated; but this is entirely foreign to my purpose, which is solely that of examining medical subjects in their strictly *legal* relations. The remarks here made are brief, and all discussions about the relative value of particular signs of pregnancy, are avoided. For these I must refer the reader to standard works on midwifery.

If we except the very few instances, in which a magistrate requires an opinion from a medical man respecting the pregnancy of a pauper female brought before him,—there are only two cases in the *English* law in which pregnancy requires to be verified; and these so seldom present themselves, that the questions connected with the pregnant state, rather belong to the science, than the practice of medical jurisprudence. The *signs of pregnancy* are commonly enumerated in the following order: 1. Suppression of the menses. With respect to this sign, it has been a question whether a woman who had never menstruated, could conceive and bear a child. Although a rare circumstance, yet cases of this kind have occurred. One will be found reported where a female, aged twenty-five, became pregnant and bore a child; and menstruation was only regularly established afterwards. (See Lancet, Feb. 1842.) Some have contended that the menses are invariably suppressed in pregnancy; but it appears that a discharge, analogous to the menstrual, if not identical with it, occasionally takes place throughout the whole period of gestation. 2. Prominence of the abdomen. The fallacies attending this sign, must be well

known to the practitioner. 3. A change in the breasts, consisting of a fulness acquired by these organs and a darkening and widening of the areolæ, with turgescence of the skin and prominence of the follicles. 4. A brown line extending from the pubes to the umbilicus, especially in females of dark complexion, and a dark coloured but not raised areola of about a quarter of an inch in breadth around the umbilicus. (Montgomery.) 5. Quickening, which is indicated by syncope, nausea and other symptoms. This may occur from the tenth to the twenty-fifth week; but it most commonly happens between the twelfth and sixteenth week of gestation. 6. Auscultation, whereby the sounds of the fœtal heart may be heard and recognized. 7. The presence in the urine of a white scum called *Keistein*. There are various opinions concerning its nature, some regarding it as a mixture of casein and oil with earthy phosphates, (Dr. Bird, G. H. Rep. April 1840, p. 26,) and others as a modification of albumen, (L' Héritier Chimie Pathologique, 483). From the late researches of Dr. Möller, its presence in the urine of pregnant women is subject to so much uncertainty, as to render it wholly unfitted to serve as a diagnostic character of pregnancy in medical jurisprudence. (Casper's Wochenschrift, ii. 1845. S. 21.) The signs above mentioned are chiefly relied on in medical practice; but it must be remembered that no case can possibly occur in civil or criminal jurisprudence, in which it will not be in the power of a medical witness to make an examination of the female. He may then form a safe diagnosis from the changes which take place in the cervix uteri and from the sensation imparted to the finger by the presence of a rounded body (like the fœtus) floating in a liquid, when an impulse is given to the uterus from below. Up to the fifth or sixth month of pregnancy, the neck of the uterus may be commonly felt projecting into the vagina; it is of its usual length, hard and firm,—after that period the uterus rises into the pelvis and the neck becomes spread out, shorter and softer, the aperture increasing in size and becoming rounder. Towards the end of gestation, the neck of the uterus appears to be lost, becoming like a thin membrane, and sometimes no aperture can be felt. The motions of the child, when distinctly perceived through the parietes of the abdomen, are a certain sign of pregnancy;—but because these motions are not perceptible to the examiner or to the female herself, it cannot be inferred that the woman is not pregnant. It is to this, as a sign of quickening, that the jury of matrons probably trust; and it is not therefore surprising that they should come to an erroneous conclusion, in cases which will be presently adverted to.

The test of pregnancy universally adopted in France—is the motion perceptible to the finger on giving a sudden impulse to the neck of the uterus. Cupuron calls this the touchstone in the diagnosis of the pregnant state:—without it, the medical jurist may be easily deceived. To this passive motion of the child, the name of *ballotement* is given. It cannot be easily resorted to before the fifth or sixth month; but after the latter period, especially as pregnancy becomes advanced, it is always available. In the French schools, the method of applying the *toucher*

and *ballotement* to pregnant females is taught, and by a little practice it may be easily acquired.

But it may be inquired what are the signs of pregnancy before the fifth or sixth month? The answer to this question is of little moment to the medical jurist, since he is never required to give an opinion under these circumstances. In all *legal* cases, it is the practice for the judge, on a representation being made by the medical witness, to postpone the decision one, two, or three months according to the time required for obtaining *certain evidence*. This evidence will consist in plainly distinguishing the motions of a fœtus, and of a rounded body floating freely in the uterus. The most experienced men agree that before the *sixth month*, the changes in the cervix and os uteri are of themselves too uncertain to enable an examiner to form a safe diagnosis; and à fortiori it is impossible to trust to external signs.

Pregnancy is sometimes *feigned*, but it is scarcely necessary to observe, that the imposture may be easily detected by a well-informed practitioner, since the woman always feigns that stage of pregnancy, indicated by considerable prominence of the abdomen, which admits of a safe diagnosis by examination. This should always be insisted on, or the reputation of a practitioner may suffer by his giving a hasty opinion on the subject. In this respect the case of *Devonald v. Hope*, Q. B., December 1838, is of some interest. A medical man having given an opinion that a female patient was pregnant, subsequently brought an action against her for medical attendance. It turned out, however, that she was not pregnant, and that there were no satisfactory medical grounds upon which his opinion was based. The plaintiff complained of having been deceived by the female as to her condition; but it is obviously in the power of every medical man to prevent such a deception being practised on him. An external examination only, will not suffice either to affirm or negative, except where it is stated to be far advanced, the allegation of pregnancy. For a singular case in which, on a charge of assault, evidence of this kind was tendered, see Med. Gaz. xxxvi. p. 1083. 1169. On the fallacy of the signs of pregnancy, and the simulation of this state, see a paper by M. Tardieu, Ann. D'Hyg. Oct. 1845, p. 429.

One of the cases in the English law, in which pregnancy requires to be verified, is of a civil nature. It is in relation to the Chancery writ "*de ventre inspiciendo.*" A woman may assert that she is pregnant at the time of her husband's death, and the heir-at-law may sue out a writ to require some proof of her alleged pregnancy, as his rights may be materially affected by the result. Until within a recent period, the decision of the question of pregnancy was left to twelve matrons and twelve respectable men, according to the strict terms of the ancient writ; but in one of the most recent cases, it was considered advisable to depart from this absurd custom, and to place the decision in the hands of medical practitioners.

In May 1835, a gentleman named *Fox* died, leaving a widow, to whom he had not been married more than six weeks. By his will, made some months

before his death, he left the great bulk of his property to the use of Ann Bakewell, spinster, for the term of her natural life, so long as she remained sole and unmarried; and after her decease or marriage, to one John Marston. Soon after the making of the will, this Ann Bakewell became the wife, and subsequently the widow of Mr. Fox. Notwithstanding that she had married the testator himself, the plaintiff Marston, claimed the property from the widow, on the ground of her having infringed the terms of the will by her marriage with the testator! She pleaded pregnancy, and in August 1835, the writ "*de ventre inspiciendo*" was sued out of Chancery by Marston. Some discussion took place in Court as to whether the writ should be issued in its original indelicate form or not: i. e., whether the female should undergo examination by the sheriff, assisted by twelve matrons and twelve respectable men! The widow petitioned the Court not to issue the writ; and put in an affidavit from her ordinary medical attendant, to the effect that she was pregnant and too weak to undergo the proposed examination. Ultimately it was decided that two matrons, with a medical man on each side, should visit Mrs. Fox once a fortnight until her delivery. There was no doubt of her pregnancy, and she was delivered at the due time to the great disappointment of the residuary legatee. (See Med. Gaz. xvi. 697; xvii. 191.) The nature of this judicial examination will be best understood by quoting the terms of the writ addressed to the sheriff. "In propriâ personâ tuâ accedas ad præfatam R. et eam coram præfatis videri et diligenter examinari et tractari facias per ubera et ventrem omnibus modis quibus melius certiorari poteris utrum impregnata sit necne." Register brevium. There can of course be no difficulty in forming an opinion in such a case, provided the pregnancy be at all advanced. It is, however, not a little singular, that in the present day, any attempt should be made to apply the customs of a rude and barbarous age, to the determination of questions which belong exclusively to medical science.

The second case in which pregnancy requires to be verified in English law, is in relation to criminal jurisprudence. When a woman is capitally convicted, she may plead *pregnancy in bar of execution*. The judge will then direct a jury of twelve married women, "*de circumstantibus*," to be empanelled, and sworn to try in the words of the law, "whether the prisoner be with child of a quick child or not." If they find her quick with child, she is respited, otherwise the sentence will take effect. In admitting the humanity of the principle by which a pregnant woman is respited until after delivery, there are two serious objections to the practice of the common law, whereby it is made to fall far short of what, in a civilized country, society has a right to expect from it: these are, 1, that the question of pregnancy is allowed to be determined by a jury of ignorant women accidentally present in Court; and 2nd, that the respite is made to depend, not upon proof of pregnancy, but upon the fact of the woman having quickened! This sign of the pregnant state (quickening) has been known to occur so early as the third, and so late as the sixth month; therefore, the execution of females under these circumstances, is a matter of accident, and must depend on the size of the pelvis and certain peculiarities in their constitution! Besides, it is a sign not easily established, except by extorting a confession from the female; and this is the only possible way in which, in a doubtful case, the question could be determined by the jury of matrons. They commonly trust to feeling the motions of the child externally, but this at particular times is a purely accidental circumstance. Lastly, it would be difficult

to assign any moral or reasonable legal principle, why those pregnant women only who have quickened, should be respited. The bare proof of pregnancy should be of itself sufficient; such is the law of France by Art. xxvii. of the Penal Code. Besides, the means resorted to by the law to determine the question are bad, and quite unfitted for the present state of society. A jury of matrons thus taken, may be easily deceived with respect to the sign of quickening, as it concerns another female. The following case will show that this may happen. (*Rex v. Wright*, Norwich Lent Assizes, 1832, see Med. Gaz. xii. p. 24, 585.)

The prisoner was found guilty of the murder of her husband by poison. She pleaded pregnancy in bar of execution. The judge empanelled a jury of matrons; and they, after a form of examination had been gone through, brought in a verdict of not quick with child. The woman would have been executed, had not several medical practitioners of Norwich represented to the judge, that the method taken to determine pregnancy and quickening, was so unsatisfactory, that no reliance should be placed upon it. The prisoner was then examined by some medical men, and was found to have passed the usual period of quickening! The judge respited the prisoner, and the correctness of the medical opinion was confirmed by the female being delivered within four months afterwards, of a healthy full-grown child. (See Med. Gaz. xii. 22, 585.) The occurrence of such a case as this, should lead to the total abolishment of the jury of matrons: and it is somewhat satisfactory to perceive by a later instance, that a better system is beginning to prevail. In a case tried in March 1838, a woman was convicted of murder, and pleaded pregnancy. A *medical* opinion was here required. The pregnancy, if it existed, had so little advanced, that the practitioner was unable to give a satisfactory opinion. The judge respited the prisoner for a month, in order that the witness might have full opportunity to ascertain the fact. But in a still more recent case, *Reg. v. Westwood*, Stafford Winter Ass. 1843, a *jury of matrons* was again summoned to examine a female capitally convicted, and they negatived the plea!

These are, I believe, the only two cases in which pregnancy has any direct relation to medical jurisprudence; and it is remarkable, that with respect to them, the law of England has expressly provided that they should be left to the decision of non-medical persons! The following conclusions may therefore be drawn: 1. That the cases in which the signs of pregnancy become a subject of *legal* inquiry in *England* are exceedingly rare: 2. That there is no case in *English* law, in which the medical man will not have an opportunity of performing an examination *per vaginam:* 3. That a medical opinion is never required by English law-authorities, until the pregnancy is so far advanced as to render its detection *certain*. Hence discussions concerning areolæ, this condition of the breasts, the presence of keistein in the urine, &c. are really unimportant to the medical jurist.

According to the Scotch law proof of pregnancy is required in charges of concealed pregnancy, under the 49th Geo. iii. c. xiv. This has rendered it necessary to establish this condition by the more common and outward signs, derived from the appearance of the woman's person,—i. e. by the areolæ around the nipples, the presence of milk in the breasts &c; but the Scotch juries wisely appear to place so

little confidence in these signs, that in the only two cases quoted by Alison, (*Smith*, 1761; *Ferguson*, 1809,) they acquitted the females. (Criminal Law of Scotland, 154.) These casual and uncertain signs of pregnancy, may be therefore of more importance in Scotch than in English practice. The editor of a respectable Scotch journal, (Dr. Seller, Northern Journal of Medicine, August 1845,) who did me the favour to notice the first edition of this work, appears to have entirely forgotten that there were any differences between the laws of Scotland and England in this respect; for he expresses perfect astonishment at the statement made by me, that (the signs of) pregnancy rarely demanded the attention of a medical jurist. The facts above mentioned appear to me to establish the correctness of this statement with respect to England: and that, so eminent a writer on the Criminal Law of Scotland as Alison, was obliged, in 1832, to go back seventy years for a case in illustration, does not favour the view that questions connected with this subject, are frequently raised or create much difficulty in that country.

It has been a question whether a woman could become *pregnant* without her knowledge. This might undoubtedly happen, where intercourse had taken place during profound sleep (lethargy,) or where she has been thrown into this state by narcotic drugs. It is very difficult to admit that any woman should remain pregnant up to the time of her delivery, without being conscious of her condition, when the intercourse took place during the waking state. A woman endowed with ordinary intellect, could not avoid *suspecting* her condition after the fourth or fifth month; and this alone would be sufficient to induce her to seek advice whereby the fact would become known to her. When a woman is impregnated in a lethargic state, it is very unlikely that she should go beyond the sixth month without being fully aware of her pregnancy, as a female with innocent motives, would undoubtedly make some communication to her friends. Capuron mentions a case of this kind, where the fact of pregnancy was first ascertained at the end of the fourth month, by the female having complained to one of her sisters of a strange sensation which she experienced in the lower part of her abdomen. (Méd. Lég. des Accouchemens, 86.) Many of the cases of this description which have been reported of unconsciousness of intercourse, are unworthy of belief. I am not aware of any case in law, wherein the *fact of pregnancy* requires to be verified after the *death* of a female. The discovery of an embryo or fœtus in the uterus, would of course at once solve the question, when the necessity for an examination occurred. If the woman had been pregnant, but the child is no longer found in the womb, then several medico-legal questions may arise in reference to delivery.

Delivery.—This subject is of interest to a medical jurist, inasmuch as it is closely related to charges connected wth the concealment of birth, abortion and infanticide. For a full account of the signs of delivery, I must refer the reader to works on midwifery; they can

here be only briefly noticed in their *medico-legal* bearings. It will be convenient to consider them, as they are found in the living and dead subjects.

Delivery in the living.—The signs of delivery are indistinct in proportion to the immaturity of the ovum, and thus when the contents of the uterus are expelled at the second or third month, the fact can rarely be verified by an examination of the female. Abortion at this period, is accompanied only by loss of blood; but at a later period of gestation, there may be a discharge resembling the lochia, and the os uteri may be found enlarged and softened. If any delay take place in making the examination, no evidence will be derivable from it. Dr. Montgomery met with an instance, in which abortion took place at the close of the second month with considerable hæmorrhage. In twenty hours, the os and cervix uteri, with the external parts, were almost completely restored to their natural state. (Cyc. Pr. Med. 504.)

The *signs of delivery* at the full period of gestation, are, 1. The female is weak, the countenance pale, and the eyes are surrounded by livid areolæ. The sudden occurrence of this state, from one of previously good health, may create suspicion. 2. The breasts are full, the nipples turgid, and the areolæ around them wide and dark-coloured. About the third or fourth day they will be found to contain milk. 3. The skin of the abdomen is relaxed, thrown into folds, and the cuticle interrupted with light-coloured broken streaks, passing especially from the groins towards the umbilicus. Dr. Montgomery has lately pointed out the existence of a dark line extending from the pubes to the umbilicus, with a dark areola around the latter in cases of recent delivery;—but he has found this line to exist independently of pregnancy and delivery,—in one case in a girl, aged ten, affected with mesenteric disease, and in another instance in a lady labouring under ovarian tumours. (Dub. Med. Jour., May 1844. 229.) The round form of the semi-contracted uterus may be felt at the lower part of the abdomen on one or the other side. 4. The external parts are swollen, contused or lacerated, with coagula of blood about them: the outlet is dilated; the perineum sometimes torn; the os uteri open and its margin relaxed. 5. The presence of the lochia. This is at first a discharge of a sero-sanguineous liquid, but which afterwards appears as a brown or green-coloured serum. It commences soon after delivery, and continues from a week to a fortnight, or even longer. This discharge has a very peculiar odour. These signs of delivery soon disappear, when there is any delay in the examination. In the generality of cases, it is considered to be difficult, if not impossible to say that delivery has certainly taken place, when the examination has not been made until after the lapse of eight or ten days. In some females, these signs become obscure after the fifth or sixth day, but in general they are obvious up to this period. The same difficulty exists in attempting to assign the period at which delivery probably took place,—a question sometimes put to a medical witness. He may be able to say whether delivery has or has not recently taken place; but he can rarely state the time except conjectu-

rally. It follows from what has been already said, that when the delivery has taken place at the seventh month or earlier, the signs will be less distinct, and cæteris paribus, will disappear sooner.

A medical jurist may be required to state, whether in a case of infanticide, pretended delivery, contested legitimacy, or disputed chastity, (*Frazer* v. *Bagley*, see post, DEFLORATION,) a woman has or has not borne a child at an antecedent period of her life. A question of this kind could only be entertained in relation to delivery at the full period of gestation. The evidence on the point, is rather loose, and is chiefly confined to the presence of shining streaks on the skin of the abdomen,—a brown mark reaching from the umbilicus to the pubes,—and the state of the os uteri, which is said never to close so effectually as in the virgin. In relation to these appearances, it would seem that a woman may be delivered without necessarily having these marks on the skin of the abdomen; and on the other hand, any morbid cause of distension in the cavity, might give rise to a similar appearance. With respect to the enlarged state of the os uteri, it must be remembered that this part may become enlarged by disease. Delivery has been often *feigned* by females, sometimes for the purpose of extorting charity, compelling marriage, or for disinheriting parties who have claims to an estate, and in other cases without any assignable motive. Of course, an imposition of this kind, could not be sustained before a medical practitioner: and detection is rendered easy because it is *recent*, and not *remote* delivery which is assumed. The latter would, if pretended, be generally cleared up by an examination, as well as by circumstantial evidence. (See case, Med. Gaz. xix. 231; also another by Capuron, Med. Lég. des Accouchemens, 110.)

Can a female be delivered unconsciously?—When by the signs of delivery and other proofs, it is established that a woman has recently borne a child, she may allege that she was delivered unconsciously. This plea is raised occasionally in cases of child-murder. There is no doubt that this may occur if the woman be labouring under apoplexy, asphyxia, or syncope;—under the effects of narcotic poisons or intoxicating liquids, but under other circumstances, it is very unusual. A woman may mistake her condition for calls of nature, and thus be delivered: this is a subject which has been elsewhere considered. (See antè, p. 480.) Dr. Montgomery relates a case where a lady who had borne several children, was unconsciously delivered during sleep, and another by Dr. Schultze is quoted in the Ann. D'Hyg. 1845, i. 216. See also a case in B. and F. Med. Rev. No. ix. 255. But it may be doubted whether in the case of a primiparous female, a delivery could possibly take place without rousing her from sleep, although it has been known to occur with little or no pain.

Delivery in the dead.—The signs of delivery in the dead body have an immediate relation to the medico-legal questions connected with criminal abortion. Death commonly ensues on these occasions within two or three days after delivery, in which case satisfactory proofs may be generally obtained on inspection;—but if the female have survived

three or four weeks, or if, as it commonly happens, the contents of the uterus have been prematurely expelled, then it is not always in our power to give a decided opinion. The contents of the uterus in these cases, are seldom forthcoming.

According to Burns, the following may be taken as the principal *post-mortem appearances*, when the body is examined soon after delivery at the full period of gestation. The uterus is like a large flattened pouch from nine to twelve inches long, its mouth being wide open. The cavity contains coagula of blood, or a sanguineous fluid, and its surface is covered with the remains of a decidua. In the part to which the placenta has been attached, the substance of the organ appears exposed, presenting several large semilunar or valvular openings. This portion of the uterus is of a very dark colour. The vessels are extremely large and numerous: the Fallopian tubes, round ligaments and ovaria, are so vascular that they have a purple colour. The spot whence the ovum has escaped, is more vascular than the rest of the ovarian surface. These appearances will be more or less marked according to the time at which the examination is made. The uterus goes on slowly contracting, and does not become fully contracted, until after about a month. The os uteri never closes so completely as it is found in the virgin state. From this account, it will be perceived that there is as much difficulty in assigning the probable period of delivery in the dead, as in the living subject:—and in determining whether or not the woman has borne a child at an antecedent period. In reference to this last question great importance has been attached to the presence of a *corpus luteum* in the ovary, on the evidence from which a few remarks may be made.

Corpora lutea.—The accounts given by obstetric writers of the characters of these corpora lutea, and the evidence which they are capable of furnishing in legal medicine, are very conflicting. Dr. Montgomery states that in the true corpus luteum the ovary presents a protuberance, with a distinct cicatrix on some part whence the ovum has escaped. The protuberant part will be found on section to have an oval form, and to be of a dull yellow colour. It is very vascular, and in texture resembles the section of a kidney. In the centre of this section there will be either a cavity or a radiated white cicatrix, according to the period at which the examination is made. The cavity remains for about three or four months after conception, and is surrounded by a strong white cyst:—as gestation advances, the opposite sides approximate, and a radiated white cicatrix results. The size and vascularity of the corpus luteum are considerably diminished by the time gestation is completed; and in about five or six months afterwards, i. e. fourteen months after its first formation, it disappears altogether from the ovary, so that the corpus luteum of one conception is never to be found with that of another, unless a premature expulsion of the contents of the uterus has taken place. (Cyc. Pr. Med. Pregnancy, 496.) The presence of a corpus luteum, as it is here described, does not prove that a woman has borne a child. In the opinion of some obstetric authorities, it

establishes that conception has taken place : but the embryo may have been converted into a mole or a blighted fœtus, and expelled at an early period. The characters of what has been hitherto denominated the false corpus luteum have been thus described. 1. There is no prominence or enlargement of the ovary generally, at the part where it is situated : 2. the external cicatrix is wanting ; 3. there are often several in both ovaries ; 4. the texture is not glandular, nor can it be injected ; 5. when laid open by section, it has neither the central cavity nor the cicatrix which results from its closure. For some remarks on the subject with medico-legal cases, and plates, see an Essay by Dr. Paterson. Ed. Med. and Sur. Jour. liii. p. 49. The conclusions to which he comes, are that the *false* are to be distinguished from the *true* corpora lutea by the following signs. They have in general an irregular form, and want either the central cavity lined with a distinct membrane or the puckered cicatrix. They have no concentric radii, and are frequently numerous in both ovaries. The same author relates the following case in order to show that the presence or absence of a *true* corpus luteum may be sometimes important in a question of disputed identity in the dead. Four medical students were charged with having disinterred the body of a lady ; but the body was so disfigured that the deceased could not be identified by her relatives. In one of the ovaries a true (?) corpus luteum was reported to have been found, a discovery which, if true, proved that it could not be the body of that lady, since she was a virgin and advanced in life. On the trial the medical evidence was very conflicting :—one half of the witnesses maintained that it was a true corpus luteum which was found in the ovary, while the others maintained that it was not !

Since the first appearance of this work, there have been many contributions to our knowledge on this subject. In opposition to the views of Dr. Montgomery and Dr. Paterson, Dr. Knox, an experienced anatomist, asserts that there is no distinctive character, whereby what has been called the *true*, can be known from the false corpus luteum, the only difference being that the latter is smaller. What have been called corpora lutea may be formed in virgin animals, independently of intercourse, and the time of their disappearance from the ovary, varies from three months to an almost indefinite period. (Med. Gaz. Dec. 22, 1843.) That there is considerable difficulty in distinguishing the true from the false corpora lutea, is proved by reference to a case reported in the Medical Gazette, (xxxiv. 623). Here, two experienced observers differed. Dr. Lee thought that the preparation which was the subject of examination, was not a corpus luteum, while Mr. Wharton Jones, thought that it was,—founding his decision on a microscopical examination. This difference of opinion, shows that a diagnosis is by no means so simple a matter as some writers assert. Mr. W. Jones agrees with Dr. Knox in considering, that a corpus luteum may occur in the ovaries, independently of coitus ; and the existence of one in this organ, would therefore afford no proof whatever of coitus having taken place. The discovery of the ovum in the uterus, *in process of develop-*

ment, could alone, in the present state of our knowledge, warrant an affirmative opinion on this point in a Court of law, and this I believe to be the safest view of this much-contested question. But on the other hand, the absence of a corpus luteum, would not warrant the opinion that coitus had not taken place. These views have received considerable support from the late researches of Professor Bischoff. (Med. Gaz. xxxv. 443, et seq.) The experimental investigations of this gentleman, appear to show that the extrusion of an ovum, or the production of a corpus luteum, is by no means necessarily connected with coitus. That the ova undergo a periodical maturation, about the time of menstruation, and escape whether there be coitus or not;—therefore that fecundation is only likely to occur when intercourse is had about this period. This would explain why corpora lutea, or bodies closely resembling them, are so often found in virgin animals, and it would also account for those differences of opinion among experienced men, which almost invariably occur when it becomes a question whether a corpus luteum be true or false This theory would further explain cases like the following reported by Mr. Elkington;—A woman aged forty-two, who had not borne a child for *seven years,* died from diseased lungs. On the right ovary were two corpora lutea, and the Fallopian tube on that side, was larger and more vascular than on the other. The deceased expected to menstruate the day she died, or at least one day later. (Prov. Med. Jour. Feb. 1845. 104.) Dr. Ritchie, of Glasgow, has lately examined this subject, and has arrived at results which tend to bear out the views of Professor Bischoff and Mr. W. Jones. He calls the bodies, corpora menstrualia vel periodica. They may, in his opinion, be formed independently of pregnancy and may possibly assume all the characters of what are called true corpora lutea by some reflex excitement in the uterine organs. According to this gentleman there are no less than eight varieties, which are liable to have their characters intermixed. (Med. Gaz. xxxvi. 985. 1058.) From these considerations, it appears to me, we can only come to the conclusion, that medical evidence respecting the nature of a corpus luteum, in an unknown case, if received in a Court of law at all, should be received with the greatest caution. The old doctrines on this subject, may be regarded as completely subverted.

The ovum or embryo.—Hitherto the examination has been confined to the female; but it will now be proper to describe the characters of the ovum or embryo, at the early stages of pregnancy, since when this can be procured, good medical evidence may be derived from an examination of it. If the ovum be expelled within a month after conception, it is scarcely possible to detect it, owing to its small size, and its being enveloped in coagula of blood. Burns examined three uteri, within the first month, where no expulsion had taken place, but even under these favourable circumstances, he failed in discovering the ovum. At first the ovum contains no visible embryo; but it appears merely to consist of vesicular membranous coverings. According to this writer when first distinctly, seen through its membranes, it

is of an oblong form and about a line (the twelfth of an inch) in length. At the sixth week, it is slightly curved, resembling, as it floats, a split pea. In the seventh week it is equal in size to a small bee; and by the end of the second month, it is bent, and as long, as a kidney bean. After this, development goes on rapidly, the features are in part well marked; and the extremities are gradually formed. At the third month, the fœtus weighs from one to two ounces:—when stretched out, it measures about three inches, and the genital organs, although the sex is not distinguishable, are large in proportion to the rest of the body. The membranes are larger than a goose's egg. At the fourth month the fœtus is from five to six inches long, and weighs from two to three ounces; at the fifth month it measures from six to seven inches, and weighs from five to seven ounces; at the sixth month, its length is from eight to ten inches, and its weight about a pound. For the characters of the child beyond this period, see antè, p. 484. The great difficulty will consist in determining the nature of the supposed ovum or embryo between the second and third month. In making the examination, it should be placed in water and all coagula gently washed away or removed by some blunt instrument. Alcohol may be used as a substitute for water, after the blood has been removed. If the embryo cannot be found, the decidua and chorion may be recognized:—the former, by its forming the outer investment with its smooth internal and rough external or uterine surface;—the latter, by the villous appearance of that portion of it, which would have become the placenta. Between the third and fourth month, the fœtus may be commonly identified without much difficulty.

Moles and hydatids.—The substance expelled from the womb may have been what is termed a mole,—a morbid production of a fleshy or of a bloody structure, appearing like a blighted ovum or placenta. It has been said that a mole is never formed in the virgin uterus; but that its presence always indicates sexual intercourse:—this point, however, is far from settled. The term mole is also attached by some to coagula of blood, polypi or hydatids. In one case reported, a mole and an ovum were expelled together, a fact which shows that they may co-exist. The symptoms accompanying a mole strongly resemble those of pregnancy:—and the appearances produced by its expulsion, are not to be distinguished from those attending the abortion of a fœtus at an early period of gestation. The only means of diagnosis, would be derived from an examination of the expelled matters. The local injury produced by the expulsion of these bodies on the organs of generation is by no means so great as that caused by delivery at the full period. The signs of pregnancy and delivery may be present in a female; and yet these may be owing to the existence of *hydatids* in the womb. It was formerly a question, whether conception or previous impregnation was or was not necessary to their formation. Dr. Koch, of Heiligenbeil has reported a case where they were probably produced independently of sexual intercourse. (Wildber

Jahrb. d. g. S. A. 1. H. 145.) When the mass is expelled, it is found to consist of a group of vesicles or cysts of various sizes:—but sometimes when this disease follows intercourse, the cysts are found mixed up with the remains of a blighted ovum or of a coagulum of blood. Unless the expelled matters be produced, it would be very difficult to say from an examination, during life or after death, whether the uterus had contained an embryo or hydatids. These morbid growths may even be enclosed in an investing membrane similar to the decidua, and there may be the remains of a corpus luteum in the ovary, but it is not likely when carefully examined in water, that they can be mistaken for an ovum or embryo.

The following case was reported by Dr. Chowne to the Westminster Medical Society, Nov. 1843. A woman was seized with pains, resembling those of labour, and a mass of uterine hydatids was expelled, which were supposed to have been in the uterus about five months. When the woman was examined, thirty-six hours afterwards, there were all the signs of recent delivery about her. The parts of generation presented the usual appearances met with on the expulsion of a fœtus; and the breasts were enlarged, the areolæ elevated, of a brown colour, the follicles prominent, and the organs evidently contained milk. The occurrence of this case led Dr. Chowne to think, that had the body of an infant been found murdered and concealed in the house where this woman lived, it would probably have been pronounced to be her child. A medical man might have strengthened the suspicion of criminality by declaring that there were all the signs of delivery about her. It may be observed, however, that in such a case, the woman would probably state that no child, but some tumour had come away from her; and a medical man would not be justified in swearing, that the appearances of delivery absolutely indicated, under all circumstances, that the woman must have been delivered of a *child*. On the contrary it is a well-known medical fact, that similar appearances might arise from the expulsion of a mole or hydatids. Circumstantial evidence would be against her, only on the assumption that some person had wilfully concealed or made away with the substantial proof of her innocence, i. e. the group of hydatids which had been expelled.

Some of the questions which have here been considered, were raised on the trial of *Angus*, for the murder of *Miss Burns*, at the Lancaster Assizes, 1808. It was alleged that the deceased was pregnant,—that the prisoner had administered corrosive sublimate to her for the purpose of inducing abortion; and that this had caused her death. A question was raised at the trial, relative te the appearances presented by the uterus as indicative of recent delivery. On examining this organ, it was found to be considerably enlarged, and on its inner surface was a mark, about four inches in diameter, plainly discernible, to which apparently the placenta had been attached. The os uteri was much dilated. Indeed the appearances were described to be such as might have been expected to be found, two hours after the birth of a full-grown child. The evidence respecting previous pregnancy was conflicting; and the prisoner was acquitted, because the death of the deceased could not be distinctly traced to any criminal act on his part. The ovaries were not examined until after the trial, when what was considered to be a corpus luteum, was found on one of them; and some eminent authorities agreed that it indicated an advanced state of pregnancy. (See Paris and Fonblanque, Med. Jur. ii. 179.) One medical witness appeared for the prisoner: and he contended that the state of the uterus did not justify the medical inference that there had been recent delivery. He assumed that the appearances might have been due to the expulsion of a group of hydatids. On the whole, the medical defence, so to term it, appears to have been more ingenious than sound; and to have rested upon assumptions, which if admitted, would effectually do away with all medical evidence in cases of criminal abortion. The contents of the uterus were not produced, a fact which left the case in mystery.

CHAPTER XLVII.

CONCEALMENT OF BIRTH. CRIMINAL ABORTION.

Medical evidence respecting delivery, is required in two cases; 1. where the birth of the child is wilfully concealed, and 2, where the contents of the uterus have been prematurely expelled by criminal means.

Concealment of birth.—The concealment of pregnancy is no offence in the English law; but the concealment of delivery, or of the birth of a child, is a misdemeanour by the 9th Geo. IV. c. xxxi. sec. 14. "Be it enacted that if any woman shall be delivered of a child, and shall by secret burying, or otherwise disposing of the dead body of the said child, endeavour to conceal the birth thereof, every such offender shall be guilty of a misdemeanor; and being convicted thereof, shall be liable to be imprisoned with or without hard labour in the common gaol or house of correction for any term not exceeding two years; and it shall not be necessary to prove, whether the child died before, at, or after its birth."

This is the offence of which those females who are charged with infanticide, are most commonly convicted, (see antè, p. 496,) while the Scotch law punishes for concealment of pregnancy. (Alison's Criminal Law, 153.) The medical evidence on trials for this offence, is exclusively derived from an examination of the mother; and thus, much will depend upon the time at which this is made. With respect to the child, its body need not even be produced provided there be satisfactory evidence of its death. In the case of the *Queen* v. *Varney*, (Oxford Lent Assizes, 1837,) it was proved, that the prisoner had been pregnant and subsequently delivered of a child. Its body had been burnt, and only a few remains of the bones of a human fœtus were found in the ashes of a grate. She was convicted of the offence. According to the statute, the child must be *dead*—the concealment of the birth of a living child not being any offence, unless it should happen to die before its birth was made known. See the case of the *Queen* v. *Woodman*, (Kingston Lent Ass. 1845,) in which the woman was acquitted because the child was living when concealed. Mr. Chitty says that the child must have advanced to the end of the seventh month; (Med. Jur. 412;) but it is to be presumed that the concealment of the birth of a dead child at the sixth or seventh month, would be as much an offence as if it were more advanced. The concealment of the aborted but undeveloped ovum—a monster, i. e. of a child without human shape, a mole or other morbid growth, would not probably be considered a contravention of the statute. Mr. Lane has communicated to the *Medical*

Times (Aug. 1845) a case in which a charge of concealed birth was dismissed by the magistrates of Surrey, because the concealment referred to a child born at the eighth month *in its membranes*. The woman stated that she did not consider it to be a child! If this view be correct, the main object of the statute (i. e. to prevent secret delivery, so often leading to murder,) is evaded. The case being entirely new, should have been sent to trial, and the decision left to the proper interpreters of the law. A magisterial decision can furnish no precedent on a question of this kind. It will be perceived, that it is not material here, as it is in a case of alleged infanticide, to prove *when* the child died, whether before, during or after birth; and thus those subtleties and technicalities which have been elsewhere pointed out (antè, p. 467,) are avoided. In regard to proof of concealment and what constitutes it, these are essentially legal points:—but a medical practitioner may sometimes benefit an accused party, if he can prove that the female had made application to him, on the subject of her pregnancy and delivery. The law is especially lenient under such circumstances. Questions connected with concealment of birth, do not fall under the jurisdiction of a coroner:—the medical evidence is therefore required by a magistrate. Medical witnesses were, until lately, exposed to much trouble on these occasions, (see Med. Gaz. xix. p. 287); but the defect has been remedied by a recent statute. (1 Vic. c. xliv.)

Supposititious children.—Another medico-legal case relative to the signs of delivery in a female, and of maturity in a child, occurs where a woman feigns delivery, and represents the child of another person to be her offspring:—or she may substitute another living child for a dead child of which she has been delivered, or for a mole or hydatids which may have passed from her. So again a male may be substituted for a female child, and vice versâ. The practising of a fraud of this nature, may seriously affect the rights of inheritance of parties; but it cannot be occomplished without great dexterity and cunning, or without the co-operation of several accomplices. Frauds of this kind have, in general, been committed by the aid of a low class of midwives. One instance occurred at Chelsea, in July 1842; where the fraud was brought to light by the death of the suppositititious child. The calling in of a professional man, would infallibly lead to discovery, when the question was simply whether delivery had or had not taken place; but if it be alleged that one living child has been substituted for another, the proof of this can only depend on medical evidence when the age of the suppositititious child, does not correspond to the pretended delivery. (See Ann. D'Hyg. 1829, ii. 227.) A remarkable case of this description, will be found in Henke's Zeitschrift der S. A. 1845, ii. 172; and a trial has recently taken place in England, involving this question, but requiring no medical evidence for its elucidation. (*Day* v. *Day*, Leicester Lent Ass. 1845.)

Criminal abortion.—By abortion is commonly understood in me-

dicine, the expulsion of the contents of the uterus before the sixth month of gestation: if the expulsion take place between the sixth and ninth month, the woman is said to have a premature labour. The law makes no distinction of this kind, but the term abortion is applied to the expulsion of the fœtus at any period of pregnancy. Criminal abortion is rarely attempted before the third month:—these cases perhaps most commonly occur between the fourth and fifth month. The causes of abortion may be either *natural* or *violent*. The latter only fall under the cognizance of the law:—but a medical witness should be well acquainted with the causes which are called natural, in contradistinction to others which depend on the application of violence. These *natural* causes are so frequent, that according to Dr. Granville's experience, one in three of all conceptions in the metropolis, terminate in abortion. These causes are commonly ascribable to peculiarities in the female system,—to the presence of uterine diseases, or to some moral shock sustained by the woman during pregnancy. The *violent* causes of abortion may be of an accidental or criminal nature. In general, the distinction will not be difficult:—the kind of violence and the adequacy of the alleged cause to produce it, will commonly clear up the case.

Criminal causes.—These are either mechanical, or they depend on the use of irritating medicinal substances. They operate with the greater certainty in proportion to the advanced state of the pregnancy. Among the mechanical causes, may be mentioned undue exercise, the violent agitation of the body, as by riding or driving over a rough pavement, in which case no marks of violence would be apparent. Any physical shock, sustained by the body, may operate indirectly on the uterus. Blows or violent pressure on the abdomen are sometimes resorted to; but in these cases, the marks of violence will be perceptible. Instruments have been devised for the purpose of piercing the membranes or destroying the child, and thereby leading to expulsion. Devergie speaks of such instruments being well known in England, and of English midwives deriving a living from the practice of this crime, a statement which it need hardly be said is founded in error! (i. 285.) Although mechanical means are more effectual than medicinal substances, in producing abortion, yet from the fact of such attempts being made by ignorant persons, the woman generally dies from hysteritis, peritonitis, or other serious after-consequences. A case was tried in the north of England some years since, in which the evidence showed that the prisoner had attempted to produce abortion in the deceased, by thrusting wooden skewers into the substance of the uterus. Inflammation and gangrene took place, and the woman died. The prisoner was convicted and executed for murder. For a similar case by Mr. M'Pherson, see Med. Gaz. xxxvi. 102. This kind of injury to the uterus, always implies the interference of some other person in the perpetration of the crime. These *mechanical means* can seldom be applied to the uterus, without leaving marks of violence on that

organ, as well as on the body of the child. If the mother die, a result which generally takes place,—an inspection will at once settle the point. (Ann. D'Hyg. 1834, 191; 1838, i. 425; 1839, ii. 109.) If the mother survive and the child be expelled, then marks of violence will be found on its body. These marks may not be sufficient to account for its death, but this is not here the question. If it can be proved that they have not resulted from accidental causes subsequently to delivery, then their presence will furnish strong corroborative evidence of the actual means by which abortion was attempted. It is said that abortion has been in some instances accomplished by frequent venesection. This effect may follow from the violent shock produced by the loss of a large quantity of blood. An examination of the veins of the arms, would show whether any such attempt had been made.

Medicinal substances are perhaps more frequently resorted to for inducing criminal abortion than other means; but they rarely answer the intended purpose, and when this result is obtained, it is generally at the expense of the life of the mother. Mineral poisons have been ignorantly employed for this nefarious object, as arsenic, corrosive sublimate, sulphate of copper and other irritants. Croton oil, gamboge, aloes, (Henke, Zeitschrift, 1844. ii. 203,) elaterium and other drastic purgatives, have also been used for a similar purpose. Purgatives which produce much tenesmus, or powerful emetics or diuretics will readily excite abortion in the advanced stages of pregnancy; but these violent medicines fail in their effect at the earlier stages. The substances just mentioned have an indirect action on the uterus by producing a shock to the general system:—but it is said there is a certain class of bodies called emmenagogues, which have a specific action on the uterus itself. Among these the ergot of rye, or secale cornutum, is particularly mentioned. This substance has been found, in many instances, to bring on violent action of the uterus at an advanced stage of gestation, or when efforts at parturition had already commenced. There is, however, considerable difference of opinion respecting its emmenagogue properties. According to Dr. Lee, it has no effect, at least in the *early* stages of gestation, although given in very large doses. (Med. Gaz. xxv. 10; see also Ed. Med. and Surg. Journ. liii. 27.) Dr. Kluge, of Berlin, found that its properties varied according to whether it was gathered before or after harvest;—in the former case, it had an energetic action, while in the latter it was powerless. The properties of the secale are not at all known to the vulgar; and this may account for the fact of our rarely hearing of cases where it has been criminally administered to pregnant females. Dr. Beatty has lately stated that when used in obstetric practice it is liable, by absorption into the system of the mother, which may take place within two hours, to endanger the life of the child. (Dub. Med. Jour. May 1844, 202.) Among substances which have acquired popular repute as abortives, are savin, rue, iron filings, squills, black hellebore and cantharides. None of them have any influence on the uterus, except in

affecting it indirectly by their irritant action on the system. For an account of the properties of savin, see antè, p. 204. In the coroner's return for 1837-8, there were four cases of the administration of savin and other drugs with the view of procuring abortion. In three of these cases, the mother died undelivered : in the fourth, the child perished. With respect to the signs of abortion in the female, living or dead, see DELIVERY, antè, p. 505 et seq.

On trials for criminal abortion perpetrated or attempted, a medical witness must be prepared for a close examination on the specific emmenagogue properties of the drug administered. A very instructive case has lately occurred, (*Reg.* v. *Calder*, Exeter Lent Ass. 1844,) which has been ably reported with comments, by Dr. Shapter, Prov. Med. Journal, April 10, 1844. It was alleged in this case, that Savin, Cantharides, and Ergot had been respectively given by the prisoner, a medical man, for the purpose of procuring miscarriage. The prosecutrix was a woman of notoriously bad character, and the prisoner was acquitted. There were three medical witnesses, who agreed that savin and cantharides were only likely to occasion abortion indirectly, i. e by powerfully affecting the system—the view commonly entertained by professional men. Some difference of opinion existed with regard to *ergot*. Dr. Shapter stated in his evidence, that he did not think the ergot would act unless the natural action of the uterus had commenced,—a statement supported by a number of authorities. Subsequently to the trial, he collected the observations of many obstetric writers, and so far modified his opinion, as to admit, that the ergot might *occasionally* exert a specific action on the uterus, in cases of advanced pregnancy, where uterine action had not already commenced. His summary on this subject is one of the best which has been published, (loc. cit.) Dr. Ramsbotham has reported three cases, from which it would appear, that the ergot may in some instances, exert a direct action on the impregnated uterus. In these instances, the females were in or about the *eighth* month of pregnancy. (Med. Gaz. xiv. 434.) Dr. J. H. Davis also believes that it is a specific excitant of uterine action, and points out the cases in which, in his opinion, it may be safely employed. (Lancet, Oct. 11, 1845, 393.) The reader will find a large collection of cases, illustrating the properties of this drug, in Wibmer. (Arzneimittel und Gifte, ii. 80. *Sphacelia Segetum.*) There appears to be less doubt about the action of *savin*. In a case, which I was lately required to investigate, various questions were put as to whether this substance, which had here been taken in the state of powder, and had caused the death of the female, exerted any specific action on the uterus to induce labour. The reply was given, that it acted only indirectly as an abortive by its powerful irritant properties. (See Med. Gaz. xxxvi. p. 646.) In these cases, it must be remembered, that the infusion is more powerful than the decoction ; since the poison, being a volatile oil, is dissipated by long boiling. Savin is, however, most commonly taken or administered in the form of powder.

The action of the most powerful mineral irritant poisons has sometimes no effect on the uterus. In July 1845, a case was referred to me for examination by Mr. T. Carter of Newbury, in which a female aged twenty-two years, who had passed the fifth month of pregnancy, took a large dose of arsenic, and died in less than seven hours, having suffered from severe vomiting and purging during that time : yet abortion did not take place! In reference to the medicinal use of mercury, it may be proper to state, that Dr. Salomon has reported two cases, in which premature delivery appeared to follow the mercurialization of the system. (Casper's Wochenscrift, June 1845; Med. Gaz. xxxvi. p. 658.)

The English *law* relative to criminal abortion, is laid down in the statute 1 Vict. c. lxxxv. s. 6. By it, capital punishment, which for-

that before a practitioner resolves upon performing an operation of this kind, he should hold a consultation with others; and before it is performed, he should feel well assured that delivery cannot take place without greater risk to the life of the mother, than the operation itself would create. These rules may not be observed in practice; but the non-observance of them is necessarily attended with some responsibility to a practitioner. In the event of the death of the mother or child, he exposes himself to a prosecution for a criminal offence, from the imputation of which, even an acquittal will not always clear him in the eyes of the public. Within the last few years, several practitioners have been tried upon charges of this kind, whether justly or unjustly it is not necessary to consider; but one fact was clear, they neglected to adopt those simple measures of prudence, the observance of which would have been at once an answer to a criminal charge. Because one practitioner may have frequently and successfully induced premature labour without observing these rules, and without any imputation on his character, this cannot shield another who is less fortunate. A charge is only likely to arise where a man has been unfortunate; and the responsibility of one operator, cannot be measured by the success of others. For a case in which a surgeon was transported for seven years, on conviction for this crime, see Alison's Criminal Law, 628.

Among other points to which a medical jurist has to direct his attention in charges of criminal abortion, are the following. 1. *Would the law apply to attempts made on females who were not pregnant?* In this case, he would have to verify the fact of pregnancy if disputed. A female may fancy herself pregnant, when she is labouring under ovarian dropsy, or other uterine or abdominal disease. Under this mistaken view, an attempt may be made to procure abortion, and the proof of the corpus delicti, will here rest with the medical evidence. It is not a little remarkable, that the *pregnancy* of the female is not alluded to in the statute:—the words being,—"procure the miscarriage of any woman." These might at first sight appear to include the state of pregnancy; but as we shall presently see, the term "miscarriage" has a much more extensive meaning than this in a popular sense. The question in reference to pregnancy has been variously decided by our judges:—but whatever may have been the intention of the prisoner, or the effects on the female, the crime cannot medically speaking be considered as complete, unless she was pregnant at the time of the attempt. It would be just as reasonable to convict an hermaphrodite of rape! A case was tried on the Midland Circuit, July, 1838, where a medical practitioner was charged with this crime. Chief Justice Tindal held that without positive proof of the woman's pregnancy, which was distinctly alleged in the indictment, a conviction could not take place. In this instance, the woman herself denied her pregnancy, and there was no evidence in support of it. The judge directed an acquittal. On the Spring Circuit of the same year, a man was tried at Lincoln, on a charge of administering a certain noxious drug to a female, with the

intent to procure a miscarriage. The jury stated their opinion, that the girl was not pregnant when she took the drug. In this case, the prisoner was discharged.

In *Reg.* v. *Haynes*, however, the prisoner was found guilty of administering a drug with intent to procure abortion, when the woman was clearly proved *not* to have been *pregnant*. (p. 113.) Mr. Justice Coltman, in addressing the prisoner, is reported to have said, that it was necessary to protect women in *such* a situation! (Cent. Crim. Court, 1843.) It is remarkable that an objection of this kind, was not taken by the counsel for the defence.

2. *Would the law apply if the child were dead in the uterus, or if it were a monster without human shape?* The symptoms indicative of the death of the child in utero, have been elsewhere stated. The death of the child subsequently to the attempted abortion, might perhaps be adduced as corroborative evidence of the crime; but if it were dead at the time of the attempt, it is uncertain whether a conviction would follow. The law is entirely silent on this point: although it cannot be doubted that the expulsion of a dead child would come under the popular signification of a miscarriage; and if the words were strictly interpreted, a prisoner might be convicted whether the child were living or dead, for it has been already said, that it is not necessary that any abortion should have taken place. With respect to monsters, the question actually arose in a case tried at Drôme, in France, in 1841. (Gaz. Méd. Juillet, 1841, also B. and F. Med. Rev. xxiv., 563.) A girl was accused of procuring abortion. The aborted fœtus, of about the sixth month, was acephalous, and there was no vertebral canal for the spinal column. Other organs were also deficient or imperfectly formed. The medical witnesses declared that it had never breathed, and that its life had ceased with gestation. On the upper part of the body was a wound, which had been produced by a pointed instrument, probably just before it was expelled. This they thought had caused death. The counsel for the prisoner contended that this could not be regarded as a case of criminal abortion, owing to the monstrosity of the offspring; and the jury acquitted her. How such a case would be decided in England it is not easy to say; but if the law in *Reg.* v. *Haynes* be correct, it would make no difference in the offence.

3. *Would the law apply to cases of extra-uterine pregnancy?* There can be no doubt that the crime of abortion would apply to cases of this description; because in law it is not required that the fœtus or child should be in any particular situation; hence a person would be equally amenable for the attempt, whether the fœtus were in the uterus, or in the Fallopian tube. The symptoms of extra-uterine pregnancy, especially of the tubal kind, are very similar to those of ordinary pregnancy;—they are not to be distinguished from them in the early stages. (See Med. Gaz. xxxvi. 103.)

The use of the word *miscarriage*, in the statute, without any explanation of the meaning assigned to it, may probably create some difficulty on trials for criminal abortion. In a popular sense, (and

here a *popular* appears to have been purposely selected in preference to a professional term,) miscarriage signifies the violent expulsion not merely of a child, but of moles, hydatids and other diseased growths, or even of coagula of blood. In these last-mentioned cases, the woman is not actually pregnant; although she and the prisoner may imagine that she is. It has been shown by cases already cited, that proof of pregnancy is, in the opinion of some judges, necessary to the completion of the crime: hence it might be expected, that where the matters expelled show no traces of embryo or fœtus, but on the contrary, are of morbid growth, these would lead to an immediate acquittal, as if the woman had never been pregnant. No case of this kind has hitherto occurred; but it has been suggested, that since these morbid growths are indicative of previous intercourse, the prisoner should be found guilty, as much as if the woman had really been pregnant. In answer to this, it may be remarked, that the necessary or constant connexion of these growths with sexual intercourse is an assumption; and admitting that the connexion was proved, it would be like punishing the individual for the intercourse, rather than for the alleged crime of abortion. It might happen that the attempted abortion was made on a woman, whose supposed pregnancy was really due to the presence of *a mole or a group of hydatids* in the uterus,—the contents of the uterus not having been expelled. If it could be proved, that the symptoms resembling pregnancy were due to a cause of this kind, the charge would probably be dismissed, for the reason that the female was not really pregnant. But how is proof of this kind to be obtained? The diagnosis is extremely difficult. It is probable that without good evidence to the contrary, the law would always presume that the female was really pregnant, and the prisoner would be convicted. Injustice might here be occasionally done: but it is clear, that if the benefit of a medical doubt of this nature were always conceded to the accused party, no conviction could ever take place for criminal abortion, when the contents of the uterus had not been expelled. When, however, the fact is certainly established that there is no pregnancy, the case is different. Abortion necessarily presupposes pregnancy; and if a woman be not pregnant, the carrying out of the intent by the prisoner, is a physical impossibility. How a man can be rightly convicted for attempting a crime which *ex naturâ rei* cannot be committed, it is difficult to understand. It is to be regretted that the statute has not been made more explicit on this subject. Under the old statute 43 Geo. III. c. lviii. the terms being "with child" were used: yet even here Mr. Justice Lawrence held that it was not necessary that a woman should be with child! (*Rex* v. *Phillips*, Paris. Med. Jur. iii. p. 88.) Some declaration is required on the law by the judges; for so important a point should not be allowed to remain in uncertainty, and subject to contrary decisions.

BIRTH. INHERITANCE.

CHAPTER XLVIII.

LIVE BIRTH. THE CÆSAREAN OPERATION. MONSTERS.

Live Birth.—The law of England has not defined the meaning of the term birth, in reference to civil jurisprudence; but if we are to be guided by the numerous decisions, which have been made on trials for infanticide, it must be regarded as signifying "the entire delivery of a child, with or without its separation from the body of the mother, (antè, p. 467.) See Chitty Med. Jur. 412. So long as an infant remains in the uterus it is said in law to be "*in ventre sa mere*;" but it is legally supposed to be born for many purposes. (Blackstone's Comm. i. 130.) A child in the womb may have a legacy or an estate made over to it,—it may have a guardian assigned to it, but none of these conditions can take effect unless the child be born alive. So the fœtus may be made an executor; but an infant cannot act as such until it has attained the age of seventeen years! The most important medico-legal questions connected with this subject, are those which arise in contested suits relative to succession or the inheritance of property. A child which is born alive, or has come *entirely* into the world in a *living* state, may by the English law inherit and transmit property to its heirs, even although its death has immediately, and perhaps from morbid causes, necessarily followed its birth. Should the child be born dead, whether it died in utero or during the act of birth, it does not acquire any civil rights; for it is not regarded a life in being, unless it manifest signs of life after it is entirely born. Some have considered that *partial birth*, provided the child be living, should suffice to confer the same rights on the offspring, as the proof of entire birth. The following case has been adduced by Dr. Locock, in support of this view; although the question here was rather in reference to the actual date of birth, than to the acquisition of civil rights therefrom:

the principle is, however, the same. On a Saturday evening, a lady was in labour with her first child. The head and one arm were born two or three minutes before a neighbouring clock struck twelve. There was a cessation of pain for several minutes, during which time the child cried and breathed freely. The rest of the body was not expelled, until full five minutes after the same clock had struck twelve. Was this child born on the Saturday or on the Sunday? Certainly the birth was not completed until the Sunday:—the child was still partly within the mother,—the circulation was still kept up through the umbilical vessels; "but," continues Dr. Locock, "I gave my opinion, that the child was born on the Saturday. I considered that the child had then commenced an independent existence. The fœtal life had then to all intents and purposes ceased; and respiration—a function incompatible with the condition of a fœtus—had commenced. The umbilical cord will, it is true, go on pulsating for many minutes after an infant has been brought completely into the world crying and kicking, unless it be compressed artificially; and yet no one will say, that the child in such a case, is not born until we choose to take the trouble to tie the navel-string. The child would not have been damaged, if it had remained for hours or even days, with merely its head and arms extruded: it could have been fed in this situation." (Med. Gaz. xii. 636.) However reasonable this view may appear, a medical jurist must shape his evidence according to what the law demands. It has been elsewhere stated (INFANTICIDE, ante, p. 467) that our judges have distinctly laid down the law, that no child can be considered to be born, until the *whole* of its body has come *entirely* into the world. This is in relation to criminal jurisprudence, in which case, if in any, the rule should be relaxed; because its relaxation would tend to punish the wilful destruction of living infants partially born. This child could not, therefore, have been born on the Saturday, because the law does not regard partial birth as entire birth; and respiration and birth are not synonymous terms. Supposing this child to have died before its body was entirely extruded, it could not be said even medically, that it was born alive; and certainly it could not be considered, according to the present state af the law, to have acquired the rights of a child born living. The reasonableness of the opinion that partial birth should suffice for all the legal purposes of entire birth, is an entirely distinct question; and one over which a medical witness has no sort of control. Whatever apparent injustice may be done by adhering to this rule in respect to the civil rights of persons, there is no doubt that the evil is really of great magnitude in relation to criminal jurisprudence; for it would appear from the present state of the criminal law, that partially-born children, although alive and healthy, may be wilfully destroyed with impunity. (p. 468.)

On the other hand, some difficulty might arise in civil cases, if the bare extrusion of part of the body, sufficed for all the legal purposes of entire birth. It might become a casuistical question, as to how much of the body should be in the world, in order to con-

stitute legal birth; for there is no reason why in a medical view, the extrusion of the head and shoulders, should constitute birth any more than the extrusion of a hand or a foot. If it be said that the act of respiration should be combined with partial extrusion, this would be unjust; because a child is alive,—its heart is evidently pulsating, and its blood circulating, as freely before the act of respiration as afterwards. Besides it is admitted, that children may be born alive and live for some time without respiring; nor is this want of respiration any objection to these children being considered living in law. A case will be related presently where a child was legally pronounced to have been alive, although it had certainly not respired. If then proof of respiration were not demanded in cases of entire, it could scarcely be required in cases of partial birth. In the event of partial, being treated as synonymous with entire birth, there would be no end to litigation; and medical opinions would vary in every case. It is doubtful whether, under such circumstances, the law could be administered with any degree of certainty or impartiality. Admitting then that a child must be *entirely* born, in order that it should acquire civil rights, it will next be necessary to examine the medical proof required to show that it has been *born alive*. The question here is different to that of live birth in reference to child-murder. We must presume that the practitioner is present at a delivery, in which a child is born in a doubtful state, or where its death speedily follows its birth. The civil rights of the child and its heirs will depend upon the careful observation made by a practitioner, of the circumstances attending the delivery. In some instances, a witness will be required to form an opinion from facts proved by non-professional persons.

The visible respiration of a child after its birth, or as it may be manifested by its *crying*, is an undoubted sign of its having been born alive: but as it has just been stated, a child may acquire its civil rights, although it may be neither seen to breathe nor heard to cry. The pulsation of a child's heart, or even the spasmodic twitching of any of the muscles of the body, is regarded as a satisfactory proof of live birth. The latter sign has been judicially so pronounced,—à fortiori, therefore, the motion of a limb will be considered good evidence in an English court of law, of life after birth. It is to be observed, that the length of time for which these signs of life continue after the child is born, is wholly immaterial:—all that is required to be established is, that they were positively manifested. A child which survives entire birth for a single instant, acquires the same civil rights, as if it had continued to live for a month or longer. These facts will be better understood from the following case of *Fish* v. *Palmer*, which was tried in the Court of Exchequer, in the year 1806.

The wife of the plaintiff *Fish*, who was possessed of property specially settled upon her, died about ten years previously to the trial, after having given birth to a child, which was supposed at the time to have been born dead. In

consequence of the plaintiff's not having had a living child (as it was assumed) by his marriage, the property settled on the wife, was claimed and taken by the defendant Palmer, her heir at law, the husband being obliged to surrender it under these circumstances. From information derived many years subsequently from some women, who were present at the delivery of the wife, the plaintiff was led to think that the child had not been born dead, and that the property had been improperly surrendered. The action was therefore brought to contest the possession, ten years after the death of his wife; and it lay with the plaintiff to prove his allegation—that the child had been born living. Dr. Lyon, the accoucheur, who attended the plaintiff's wife, had died some time before the trial: but it was proved that he had declared the child to have been living an hour before it was born, that he had directed a warm bath to be prepared, and when the child was born, gave it to the nurse to place in the bath. The child neither cried nor moved after its birth, nor did it manifest any signs of active existence: but the two women who placed the child in the bath, swore that, when it was immersed, there appeared twice a twitching and tremulous motion of the lips. They informed the accoucheur of this, and he directed them to blow into its throat; but it did not exhibit any farther evidence of life. The principal question on the trial was:—Whether this tremulous motion of the lips was sufficient evidence of the child having been born alive? The medical witnesses differed. Dr. Babington and Dr. Haighton gave their opinion that had the vital principle been extinct, there could have been no muscular motion in any part of the body:—therefore the child had, in their opinion, been born alive or manifested life after its entire birth. Dr. Denman gave a contrary opinion: he contended that the child had not been born alive, and attempted to draw a distinction between uterine and extra-uterine life. He attributed the motions of the lips after birth, to the remains of uterine life. The jury, however, under the direction of the Court, did not adopt this view of the case:—they pronounced the child to have been born living; and by their verdict, the plaintiff recovered the property of which he had been for ten years deprived. From the result of this case, it would appear that the law does not recognise the distinction attempted to be drawn by Dr. Denman, between what he called uterine and extra-uterine life. A distinction of this kind appears to be purely artificial;—respiration is commonly set down as a mark of extra-uterine life: but a child may breathe and die before it is born, or it may be entirely born and manifest indubitable signs of life without respiring. Respiration therefore is properly regarded by the English law as only *one* sign of life,—the proof of the possession of active and vigorous life, is not absolutely required. It cannot be admitted physiologically that any tremulous motion in the muscles, could ever take place spontaneously in a really dead body; and the spasmodic motion of the lips, differs only in degree from the active motion of a leg or an arm. If a certain quantity of life, so to term it, were required to be proved, instead of the bare fact of its presence or absence, the most subtle distinctions would be continually drawn:—thus it might be contended that unless a certain degree of respiration had taken place, it should be assumed contrary to well-known facts, that the child had been born dead. In this respect it appears to me that the law of Scotland must operate unjustly. The law of that country in respect to tenancy, declares that a child cannot be born alive unless it has breathed;—it therefore requires exclusive evidence of *respiration*. (Ed. Med. and Surg. Jour. xxvi. 369.) It would be as reasonable to demand for exclusive proof of life, the motion of one of the extremities, as to insist upon exclusive proof of respiration; for this so varies in degree, that a child may breathe and survive its birth many hours, scarcely receiving any air into its lungs, (ante, p. 453.) Would this be better evidence of live birth, than the distinct motion of a limb? Non-professional persons might be easily deceived as to the fact of respiration in these feeble subjects, and a post-mortem examination would not always remove the doubt;—but no one is likely to be deceived about the motion of an arm or a leg. The power by which a limb is moved, is the same as that by which the intercostal muscles are moved in the act of respiration. Besides, it is forgotten by those who

would thus restrict the proof of life, that such a restriction would be attended with great injustice; for morally speaking, the right of a husband to enjoy for life the property of a wife dying intestate, should not be made to depend upon the mere accident of a child being born, or of its having survived its birth for a few moments. For a case by M. Marc, somewhat similar, but in which the medical opinions were opposed to these views, see Ann. D'Hyg. 1838, i. 98.

On these occasions the mere *warmth* of the body of a child at its birth, would not be evidence of life:—the slightest trace of vital action in its common and true physiological acceptation, would, however, without doubt, be deemed by our law a sufficient proof of the child having been born alive. It is well for a practitioner to bear in mind that the observation of the actual *date of birth* is often a subject of considerable importance in civil suits respecting legitimacy and the succession to estates.

Vagitus uterinus.—Let us suppose that the evidence of a child having been born alive, is stated to be that it was heard to cry:—it may be a question for a medical witness in cross-examination, whether this is to be taken as an absolute proof of live birth. The answer must be in the negative, because a child may cry before its body is entirely born:—or it may be what is called *vagitus uterinus*,—a uterine cry after the rupture of the membranes. (See ante, INFANTICIDE, p. 465.) As in all cases of this description, there must be eye-witnesses, whether professional or not, the evidence cannot rest solely upon the mere medical possibility of the occurrence of such a cry before birth: and proof will be required of the crying of the child after it was born.

There are two cases in which the determination of the momentary existence of children after birth, becomes of importance in a legal point of view. These are in cases involving the questions of Possessio Fratris and Tenancy by the Courtesy.

Possessio Fratris.—In the event of a man twice married, dying and leaving a daughter, by each marriage, his estate would be equally shared by the daughters of the two marriages: but if we suppose that there is a son of the second marriage, born in a doubtful state, the legal effect of this child momentarily surviving birth, manifested by some slight sign of life, would be to disinherit the daughter of the first marriage entirely, and transfer the whole of the estate to the daughter of the second marriage, she being sister to the male heir, while the daughter of the first marriage is only of half blood. The determination of this point, which does not often occur, must rest essentially upon medical evidence, when there is a want of clear proof of life after birth. (See Amos, Med. Gaz. i. 738.)

Tenancy by Courtesy.—This signifies, according to Blackstone, (Com. ii. 426,) a tenant by the courts of England. The nature of

this tenancy has been already explained. See the case of *Fish v. Palmer*, (ante, p. 524.) If a married woman possessed of property specially settled on her, die intestate, it passes from the husband to her heir at law unless there has been a child born *living* of the marriage, in which case the husband acquires a life-interest in the property. The only defence of this singular custom, is that it is of great antiquity. An attempt was made a few years since to substitute for it the reasonable provision, that the marriage should entitle the husband to a right, which he can now only acquire by the fulfilment of certain accidental conditions. Incurable sterility, a protracted labour or deformity in the pelvis of the wife, or the necessary performance of craniotomy on a healthy well-formed child, may, under this custom, lead to an aversion of the inheritance. The tenancy in contested cases, is generally established or disproved by medical evidence: and the following are the conditions which the law requires in order that the right should exist. 1. The child must be born alive. A case has been already related wherein the tremulous motion of a lip was held to be a sufficient proof of live birth. 2. The child must be born while the mother is living. From this it would appear that if a living child were removed from the outlet after the death of the mother, or extracted by the Cæsarean operation from the uterus, the husband could not become entitled to enjoy his wife's estate; although the child may survive its removal or extraction. How such a case would be decided in the present day, it is difficult to determine: but one instance is quoted by most medico-legal writers from Lord Coke, where about three centuries since, the case was decided against the husband, in consequence of the child having been removed from the uterus by the Cæsarean section, after the death of the wife. For a very singular case involving this question in France, see Ann. D'Hyg. 1838, 98.

The *Cæsarean operation* has rarely been performed in England, except when the female was actually dying or dead. But the practice on the continent has been to undertake it while the woman was living, and the result has shown, that it may thus be performed successfully both with regard to mother and child. (See Med. Gaz. xix. 829, 878.) For a case in which this operation was successfully performed three times on the same person, see Brit. and For. Med. Rev. July 1836, 270. Important legal consequences may hereafter ensue from the adoption of this practice in England. Thus supposing, in any case, the child were removed alive, while the mother was living, both of them dying shortly afterwards,—Would the husband become a tenant by the courtesy? The law says the child must be *born:* and many lawyers would find good ground for arguing whether extraction by the Cæsarean operation, should be regarded as "legal birth." It does not seem to have been contemplated that the operation would ever be undertaken on a *living* female, and the point is therefore left undetermined. In some instances, the operation may be unnecessary. Sir B. Brodie mentions a case which occurred in a French hospital, of a

woman whose pelvis was considered to be too narrow for the egress of the child. As she was at the full term of gestation, the Cæsarean section was proposed, but before the operators were ready to commence, the child was expelled by the natural efforts of the uterus, or as Sir B. Brodie expressed it, the child preferred coming into the world by the old road! (Lancet, Dec. 1843.)

That a child may be born *after the death* of the mother, and survive its birth, is proved by the following case. A woman died during labour. The accoucheur who was summoned, found the head of the child presenting, but too high up in the pelvis to allow of the application of the forceps. He immediately introduced his hand into the uterus, and a quarter of an hour after the death of the mother, and twenty hours after the rupture of the membranes, he extracted a male infant in a state of apparent death. The child, which was well-formed, was speedily resuscitated by the application of the ordinary means. (Berlin Medicin. Zeit. July 1836.) Had this case occurred in England, it would probably have been decided according to the old precedent, that the husband could not become a tenant by the courtesy.

3. The child must be born capable of inheriting; therefore if it be a *monster,* the husband does not acquire the right. There are some other legal conditions which must also be fulfilled, but I have here confined myself to what may become matter for medical evidence. Admitting that there are many legal ways by which the obnoxious parts of this custom may be set aside during the life of the mother, it is hardly just that the knowledge of the necessity for these precautions, should be left to be acquired by accident. It would be better to abolish the custom altogether than to allow the right of the husband to rest upon the execution of a deed, in order to obviate the injustice which must now necessarily attend its operation. (See the case of *Fish v. Palmer,* ante, p. 525.)

Date of birth.—Medical evidence has occasionally been demanded in Courts of law respecting the actual date of birth of particular parties, in cases where a period of a few days, hours, or even minutes, was required to prove the attainment of a majority,—and therefore legal responsibility for the performance of civil contracts into which the parties had entered, either knowingly or ignorantly when minors. Some such cases have been decided by the evidence of the accoucheur himself,—others, when the accoucheur was dead, by the production of his books; and it is worthy of notice that the strictness and punctuality of some medical practitioners in making written memoranda of the cases attended by them, have in more than one instance, led to a satisfactory settlement of such suits, and the avoidance of further litigation.

Plural births.—This has been regarded as a subject appertaining to

medical jurisprudence; but I am not aware that there is any case on record, in which the evidence of a medical man was called for respecting it. It is a simple question of primogeniture, which has been generally settled by the aid of depositions or declarations of old relations or servants present at the birth. Women may have two, three, four, or five children at a birth. Twins are comparatively frequent, but triplets and quadruplets are very rare. According to Dr. Rüttel, out of 574,293 births in Prussia, in 1840 there were 6381 cases of twins, 72 triplets and one of quadruplets. This writer knew an instance in which a woman had six children at a birth. (Henke Zeitschrift, 1844, 266.) The only circumstance with respect to these plural births which it has been recommended that an accoucheur should attend to, is the order of their occurrence. The first born child, according to the ancient principle of the common law of this country, succeeds to the inheritance. In cases of twin or triplet males, a practitioner would find himself much embarrassed to express an opinion as to which was first born after the lapse of a certain period, unless there were some personal peculiarity or deformity which would at once stamp the identity.

There is one case in which the law has interfered to prevent the inheritance of offspring, and this is in relation to monstrous births.

Monsters.—The connection of teratology with medical jurisprudence, has been most ably investigated by M. Geoffroy St. Hilaire. Although questions connected with these beings do not often occur, yet it is proper that a medical witness should be acquainted with certain facts respecting them. The law of England has given no precise definition of what is intended by a monster. According to Lord Coke, it is a being "which hath not the shape of mankind; such a being cannot be heir to or inherit land, although brought forth within marriage." A mere deformity in any part of the body, such as supernumerary fingers or toes, twisted or deformed limbs will not constitute a monster in law, provided the being still have "human shape." From this it is obvious, that the law must be entirely guided in its decision by the description of the monstrous birth given by a medical witness. It would not rest with him to say, whether the being was or was not a monster—the Court would draw its inference from the description given by him. Various classifications of monsters have been made, but these are of no assistance whatever to a medical jurist, because each case must be judged of by the peculiarities attending it; and his duty will be not to state the class and order of the monster, but simply in what respect it differs from the healthy organized being. In consequence of the want of a sufficient number of precedents on the subject, it is difficult to say what degree of monstrosity would be required in law in order to cut off the civil rights of the being. There are acephalous, dicephalous and disomatous monsters; others, again, like the

Siamese twins, two bodies united by a mere band of integument. Would an acephalous monster be considered as devoid of human shape? Would a disomatous monster be allowed to inherit as one?—to marry as one,—or how would legal punishment be inflicted in the event of one of the bodies infringing the laws? Such are the singular questions which have been proposed by medical jurists in relation to these beings. There would obviously be ample room for the exercise of much legal ingenuity in respect to these questions. According to St. Hilaire, the rule which has been followed in all countries, respecting these monstrosities, is to consider every monster with two equally developed heads, whether it be disomatous or not, as two beings; and every monster with a single head, under the same circumstances, as a single being. He ascribes the origin of this rule to the performance of the rite of baptism in all christian countries upon each head, where the monster was dicephalous. This view certainly appears rational, when we consider that with two heads there are two moral individualities, while with a single head there is only one will and one moral individuality. But it is doubtful how far this doctrine would be received by jurists and legislators. The question whether in a dicephalo-disomatous monster, the two beings should be bound by the act of one, either in civil or criminal jurisprudence, is a matter which, if these monstrosities were more frequent, would give rise to serious difficulties. Such a question is not purely speculative, because it might easily have been raised in respect to the Siamese twins during their stay in this country; and according to St. Hilaire, a case of this kind was actually decided in Paris in the seventeenth century, in relation to a double-headed monster. This author relates that the double monster killed a man by stabbing him with a knife. The being was condemned to death, but was not executed on account of the innocence of one of its component halves! (Ann. d'Hyg. 1837, i. 431.) According to the same authority, compound monstrosity is not transmissible by generation. Monsters, especially the dicephalous, are either born dead or die very soon after birth, yet within a recent period, two have been known to live, the one Christina Ritta, for nine months,—the other, the Siamese twins, for many years,—the latter may be still living. (See a paper by Dr. Rüttel, Henke Zeitschrift, 1844, 229.)

Malpositions, transpositions, or defects of the internal organs of any of the cavities, cannot form monstrous births within the meaning of the English law. The legal question relates only to *external* shape, not to *internal* conformation. It is well known that many internally malformed persons live to a great age; and it is not until after death that malpositions and defects of this kind are discovered. In French jurisprudence, the case appears to be different; if the malposition or defect were such as to be the cause of death soon after birth, the child would be pronounced not "*viable*," and incapable of assuming its civil rights. Some medical jurists have discussed the question of "viability" in new-born children; i. e., their healthy organization

with a capacity to continue to live, as if it were part of the jurisprudence of this country; but I am not aware of any facts which bear out this view. The English law does not regard internal monstrosity, and the case of *Fish* v. *Palmer*, shows clearly, that the simple question in English jurisprudence is, not whether a child be or be not "*viable*," but whether it manifested the least sign of life after it was born. The French law is much more complex, and throws a much greater degree of responsibility on French medical jurists.

LEGITIMACY.

CHAPTER XLIX.

GESTATION. PREMATURE BIRTHS. PROTRACTED BIRTHS. PATERNITY.

Every child born in lawful matrimony is considered by the English law to be the child of the husband, unless the contrary be made clearly to appear by medical or moral evidence, or by both combined. It is only in reference to *medical* evidence that the subject of legitimacy can here be considered; but it is extremely rare to find a case of this kind determined by medical evidence alone. There are generally circumstances which show that the child, whose legitimacy is disputed, is the offspring of adultery, while the medical facts may be perfectly reconcilable with the supposition that the claimant is the child of the husband. These cases have been therefore repeatedly decided from *moral* evidence alone,—the medical evidence respecting the period of gestation or physical capacity in the parties, leaving the matter in doubt. The law which formerly prevailed in this country was to the effect, that if a child were born during marriage,—the husband being within the four seas of the realm, (*quatuor maria,*) and no physical impossibility being proved, the child was legitimate. Access was presumed, unless he could prove that he was "*extra quatuor maria*" for above nine months previously to the birth. (Blackstone, i. 456.) But the present state of the English law on the subject appears to be this. A child born during marriage is deemed illegitimate when by good medical or other evidence it is proved that it was *impossible* for the husband to be the father,—whether from his being under the age of puberty, from his labouring under incapacity from age or natural infirmity,—or from the length of time which may have elapsed since he could have had intercourse, whether from absence or death. With proof of non-access or immorality on the part of the mother, so important on these occasions, a medical witness is not in the least concerned. In some instances, the law assumes without medical evidence that the offspring is illegitimate, as where the husband and wife have been legally divorced "*a vinculo matrimonii.*" When children are born where the divorce is "*a mensâ et thoro,*" they are presumed to be illegitimate until the contrary appear. There is a peculiar difference in relation to legitimacy between

the laws of England and Scotland. A child born of parents in Scotland before marriage is rendered legitimate by their subsequent marriage. In England the offspring is illegitimate, whether the parents marry or not after its birth. In the case of *Birtwistle v. Vardell,* decided on appeal by the House of Lords in August, 1840, it was held that a child thus legitimated by the law of Scotland, could not be allowed to succeed to his father as heir to real estate in England. The Scotch rule appears more consistent with natural justice; since according to the English practice, it is inflicting confiscation on the offspring for a fault in the parents, which they had done all that it was in their power to amend. (See also the cases *Munro v. Munro. Dalhousie* v. *M'Douall* on Appeal to the House of Lords, March 1840.) In the case of *Munro v. Munro* the child was born during the residence of its father, a Scotchman, in England, but this was not considered to invalidate the application of the principle of Scotch law. These suits are chiefly instituted in respect to the right of succession to property or claims for peerages; and medical evidence is then frequently required to clear up the case. From what has been already said, the English law does not regard the date of *conception,* which cannot be fixed, but the date of *birth,* which can be fixed. Medical evidence may relate, 1, to the actual length of the period of gestation:—this may be in a given case so short or so long, as to render it impossible that the husband could be the father. 2. There may be physical incapacity in the husband—he may be too old or too young—or he may labour under some physical defect rendering it impossible that he should be the father. 3. There may be sterility or incapacity in the female, rendering it impossible that the child should be the offspring of a particular woman:—in other words, it may be a supposititious child. (See ante, p. 513.)

Gestation.—The first point to be considered is—what is the natural period of gestation, and whether this is fixed or variable. According to the testimony of the most experienced accoucheurs, the average duration of gestation in the human female, is comprised between the thirty-eighth and fortieth week after conception; but it would appear that the greater number of children are naturally born between the thirty-ninth and fortieth weeks. One cause of this great variation may be, that the common mode of calculation by reference to the suppression of the menstrual discharge, even in a healthy female, must lead to a possible error of two weeks, since there is no sign whereby, in the majority of women, the actual period of conception can be determined: although the late researches of Bischoff appear to show that it must always be at or about the time of menstruation and not at an intermediate period. (Med. Gaz. xxxv. 443, et seq.) On the other hand, accidental cases have already shown that a great difference exists among females naturally, with respect to this period; and it is probable that in no two, is it necessarily the same. Thus where there has been only one intercourse, the duration of pregnancy might be

easily calculated without reference to any changes in the female constitution: for thereby the date of conception would be accurately fixed. Observations of this kind have shown that females have differed from each other, and that in several instances they have exceeded the period of forty weeks, which has been usually set down as the furthest limit of natural gestation. Some have supposed that this difference depended on the male, from analogical observations made on animals, but it more probably depends on differences in the female constitution.

PREMATURE BIRTHS.—From the preceding remarks we may regard all births before the thirty-eighth week as premature, and all those which occur after the fortieth week as protracted cases; and one great point for a medical witness to determine will be, whether the characters presented by a child, correspond to those which it should present, supposing it to be legitimately born. When the birth is premature, this sort of corroborative evidence may be sometimes obtained; because children born at the fifth or sixth month after marriage cannot, if the offspring of the husband, present the characters of those born at the full period:—supposing that there has been no access between the parties before marriage. It is not so with protracted births; for it is never found that the children are more developed in protracted cases, than they are in those which occur at the full period. For an account of the characters presented by children at different ages, see ante, p. 434, 510. In judging from these *marks of development*, we must make full allowance for the exceptions to which they are liable. The nearer the supposed premature delivery approaches to the full period of gestation, the more difficult will be the formation of an opinion. Although the characters of a seven months' child are usually well-marked, and may be known by common observation, it is not always easy to distinguish a child born at the eighth from one born at the ninth month. Burns observes that it is possible for gestation to be completed, and the child perfected to its usual size, a week or two sooner than the end of the ninth month, and other accoucheurs corroborate this view. Thus then a child, born at the eighth month, may be the offspring of the husband:—at the ninth, of an adulterer, but medical facts could not enable a witness to draw any distinction. It is here that moral proofs are necessary; for without these the fact of legitimacy in such a case could not be successfully contested. The *survivorship of a child* has been supposed to furnish additional evidence; for it is well known, that under a certain age children are not born living, or if born living they speedily die. Therefore it has been argued, if a child born at the fifth or sixth month after the first cohabitation, be born living or survive, this should be taken as a proof of its illegitimacy. The following remarks will, however, show that an argument of this kind may be overstrained.

A medical witness has sometimes been asked—What is the earliest period at which a child can be born to enable it to live and to continue

in life after its birth? It is now universally admitted, that children born at the seventh month of gestation are capable of living, although they are more delicate, and in general require greater care and attention to preserve them, than children born at the ninth month:—the chances are, however, very much against their surviving. It was the opinion of Dr. William Hunter, and it is one in which most obstetric authorities agree, that few children born before the seventh month are capable of arriving at maturity. They may be born alive at any period between the sixth and seventh month, or even in some instances earlier than the sixth: but this is rare, and if born living they commonly die soon after birth. There is one case on record of a child having been born living so early as the fourth month of gestation, (Brit. and For. Med. Rev. ii. 236,) and one in which a child born at the fifth month survived upwards of twelve hours, is reported by Mr. Smythe. A female in her second pregnancy, and in the 147th day of gestation, had a severe flooding, with rupture of the membranes. Labour occurred on the following night, when a small but well-formed fœtus was expelled, giving no other indication of life, than a feeble action of the heart and a strong pulsation in the cord. It was resuscitated and cried as strongly, as a child born at the full period of pregnancy. It weighed less than two pounds and measured exactly twelve inches. It swallowed some nourishment, but died about twelve hours after birth. The membranæ pupillares were entire,—the testicles had not descended,—the head was well covered with hair. From peculiar circumstances, it was evident that the mother of the infant was correct in respect to dates. There was clearly nothing in the organization of the child, to prevent its growing to the age of maturity; in other words, it was *viable*. (Med. Chir. Rev. July, 1844, 266.) Another case is reported in which a child born at five months and a half, survived its birth between three and four hours. (Med. Gaz. xix. 865.) Capuron mentions an instance where a child was born at the sixth month and a half of pregnancy, and at the time he reported it, the child was two years old and enjoyed excellent health. In another case, the child was born at the same period, and lived to the age of ten years. (Méd. Lég. des Acc. p. 162, 208.) In an instance which fell under my own knowledge, a child was born at the sixth month and a half of gestation, and lived a fortnight. (See another case, Med. Gaz. xxxii. p. 623.) Capuron considers that a child born at the one hundred and eightieth day, or at the sixth month after conception, might be sufficiently mature to live, i. e. that there would be no reason to presume that it was illegitimate, merely because it survived its premature birth. On the other hand, if born before the sixth month, with sufficient maturity to live, this fact, although by no means a proof, affords a strong presumption of its illegitimacy. For some remarks on this subject by Dr. Rüttel, see Henke Zeitschrift, der S. A. 1844, i. 241. Such, I believe, are the principal medical facts connected with the question of premature births; and the following singular case will

serve as an illustration of the difficulties sometimes experienced in forming a medical opinion.

In October 1835, an investigation (*"fama clamosa"*) took place before one of the Presbyteries of Scotland, in reference to certain reports which had been circulated to the prejudice of a minister of the district. It appears that the marriage of this gentleman took place on the 3d of March, and his lady gave birth to a female child on the 24th of August following ;—i. e. one hundred and seventy-four days, or nearly *six calendar months* after the marriage, and the child continued to live until the 20th of March 1836. When born it was very weak, and according to the evidence of the accoucheur and others, who saw it, it was decidedly immature. The birth of a living child, together with its survivorship for so long a period, led, however, to the report that there must have been intercourse between the parties previous to the marriage. It was contended that the period was too short for the child to have been begotten in wedlock. Dr. Hamilton, of Edinburgh, on being applied to by the Presbytery, said that his own experience was opposed to the probability of a child born at the sixth lunar month surviving ; (the time in this case was six lunar months and six days ;) but he referred to two cases where children born under similar circumstances, had survived their birth for a long period. In one, the lady was delivered within five lunar months (twenty weeks) after the marriage, and Dr. Pitcairn and others gave it as their opinion that it had been begotten within wedlock : in the other, a woman gave birth to a child nineteen weeks after conception, and it lived a year and a half. Dr. Thatcher, who examined the child in the case here reported, nineteen days after its birth, gave his opinion that it might have been begotten on or after the 3d of March ; and the circumstance of its having been reared in the premature state in which it was born on the 24th of August following, was no objection to this opinion. He considered the complaint made against the minister, groundless. The case went through several appeals, and was not finally decided until May 1839, when the libel was found not proven, and the defendant was absolved from censure. Many medical witnesses gave evidence on this occasion—the majority of them being strongly in favour of this having been a legitimate and premature birth. (See Record of Proceedings, &c., Edinburgh, 1839. Med. Gaz. xvii. 92 ; also Med. Chir. Rev. xxxi. 424.) Although not connected with the medical part of the case, it should be observed that the character of the parties was free from all suspicion,—that no concealment had been practised by them, and that no preparation had been made for the early birth of the child. There were, it is true, unusual marks of development about this child, considering the early period of its birth, yet these were not sufficient, any more than the fact of its surviving, to induce the belief that it was begotten out of wedlock. One case has been already mentioned, where a child at a still earlier period, survived several hours, and others, where children born rather later, lived for two and ten years. It would be in the highest degree unjust to impute illegitimacy to the offspring, or a want of chastity to the parents, merely from the fact of a six months' child being born living and surviving its birth. There are indeed no medical grounds for adopting such an opinion, a fact clearly brought out by a question put to Dr. Campbell, the chief medical witness in favour of the alleged antenuptial conception. In his examination in chief, he admitted that he had himself seen the case of a six months' child who survived for *several days*. He was then required to say whether he could assign any reason why, if after such a period of gestation it is possible to prolong life for *days*, it should not be possible to extend it to *months !* He could obviously give no reason. (Record of Proceedings, &c. 55.)

PROTRACTED BIRTHS.—The question of retarded gestation has given rise to considerable discussion in legal medicine. That gestation may

be retarded or protracted beyond the fortieth week, is now scarcely disputed by an obstetric writer of reputation. Some individuals have denied it, because they have not met with such cases in their own experience; but the medico-legal relations of such questions, do not depend upon the solitary experience of practitioners. It is only by the accumulation of well-ascertained facts from all authentic sources, that medical knowledge can be made available to the purposes of the law—otherwise by the mere accident of a witness not having met with any exceptional case, a Court may be entirely misled in its judgment by trusting to his opinion. It is the more important to attend to this; because most of the cases, involving questions of contested legitimacy, or the chastity of individuals, turn upon protracted rather than upon premature delivery.

In the standard works on Midwifery, will be found authentic reports of cases where gestation continued to the forty-first, forty-second, forty-third, and even the forty-fourth week. Dr. Lee recently met with a case in which he had no doubt that the pregnancy lasted two hundred and eighty-seven days:—the labour did not take place until forty-one weeks after the departure of the husband of this lady for the East Indies. (Med. Gaz. xxxi. 917.) Dr. William Hunter met with two instances where gestation was protracted until the forty-second week. Dr. Montgomery met with a case in which delivery did not ensue until between the forty-second and forty-fourth week. (Med. Gaz. xix. 646.) But perhaps the most complete evidence of protracted gestation, as well as the general uncertainty of the duration of that state, is furnished in a table by Dr. Merriman, and quoted by Dr. Lee. (Med. Gaz. xxxi. 917.) Of one hundred and fourteen pregnancies calculated by him from the last day of menstruation, and in which the children appeared to be mature, the following were the periods:—

In the 37th week	3	In the 41st week	22
38th	13	42nd	15
39th	14	43rd	10
40th	33	44th	4

From these results Dr. Merriman thinks that the greater number of women complete gestation in the fortieth week, and next to that in the forty-first. The name of Dr. Merriman is a sufficient guarantee for the authenticity of these cases. Among the longest cases which I have found reported is one by Dr. Beck. (Med. Chir. Rev. xxxiv. 556.) It occurred in America in 1840:—gestation was here protracted to three hundred and thirteen days, or forty-four weeks and five days: but more recently, Dr. Murphy has reported two cases in which gestation extended to 314 and 324 days respectively, or in the longest case to *forty-six weeks* and two days. This gentleman considers that the *average limit* of gestation is three hundred and one days or forty-three weeks. (See Lancet, Nov. 30, 1844.) It has been supposed that these cases of lengthened gestation, were nothing more than

instances of protracted parturition: the delivery commencing and continuing over a much longer period than usual. In an instance mentioned by Dr. Jörg, a woman went her full time; but the parturition lasted a fortnight longer, the symptoms appearing and then disappearing. Admitting that this occasionally happens, still it shows that gestation from a particular pregnancy, may be protracted considerably beyond the ordinary period. It is impossible to admit that these cases depend upon some mistake being made in the calculation of the period:—since this calculation was founded on the same principles as those adopted in cases of ordinary pregnancy. Hence, if there was a mistake in the one case, there would be in the other: if an error in the exception, there would be an error in the rule. Either pregnancy is wrongly calculated at the thirty-eighth and fortieth week, or it is rightly calculated to extend occasionally to the forty-fourth week. But even setting aside the palpable answer to an objection of this nature, some of the cases having been instances of impregnation from one intercourse, it is quite impossible that any such mistake could have arisen respecting them.

In all cases of contested legitimacy, the question respecting the *period of gestation*, when it arises, is left entirely open by the law. No period has been fixed within which, or beyond which, a child when born in wedlock, should be presumed illegitimate. The decision of a Court of law would be founded, quoad the duration of pregnancy, on the opinions of experienced practitioners selected for the occasion, and each case would be decided on its own merits. Precedents can have but little influence on these occasions, because a Court may think fit to pronounce illegitimate on non-medical grounds, a child born in the thirty-eighth week of gestation; while it may decide that another was legitimate that had been born in the forty-third week. By some law-authorities *forty* weeks are set down as the "*ultimum tempus pariendi:*"—but the impression among jurists and physicians in modern times being that the period of human gestation is wholly independent of any legal dictum, it is not the custom of the Courts to act upon this as a rule. In two instances children have been pronounced legitimate, which were born, the one in forty-one weeks and three days, and the other in forty-one weeks and four days after the death of the husband. In the following case (*Anderton* v. *Gibbs*, 1834) the Vice-Chancellor decided that a child born ten months or about forty-two weeks after intercourse with the husband, was legitimate.

In this case, a verdict had been already returned, establishing the legitimacy of the plaintiff; and an attempt was now made to set this aside, among other grounds, upon the plea that the offspring was illegitimate, because it had been born at so long a period after access. It appeared that the mother of the plaintiff had been living for some time before, and at the period of the birth, in adulterous intercourse; and that about ten months before the birth of this child, she had had a private interview with her husband, when it was assumed that there had been access, bnt the parties did not meet afterwards. Before the adultery, they had lived together two years without having had issue; and in the present instance the child was born after a period of *forty-two weeks*,

facts which were considered to establish its illegitimacy. The opinions of Sir Charles Clarke and other medical men were adduced at the trial; and these limited the extreme period of gestation to forty weeks; but they at the same time declared that the subject was involved in darkness and uncertainty. The Vice Chancellor considered that the jury at the trial had given a proper verdict by finding for the plaintiff's legitimacy. The jury were not to decide by whom the child had been *begotten;* but whether it could by any possibility be the child of the husband. With respect to the period of gestation, there was no difficulty. Sir Charles Clarke and other authorities confessed that the subject was involved in darkness and mystery; and that the faculty of medicine knew nothing certain about it. There was no positive evidence as to the exact day on which the child was born, nor on which the interview between the husband and wife took place. Therefore this would allow of the period of gestation being reduced to about forty-two weeks or less. The legitimacy of the plaintiff was in his opinion legally established. From this case it will be seen that a child may be affiliated on the husband, although the wife may be at the same time living in adulterous intercourse with another person.

One of the most interesting cases in relation to this subject was the *Gardner Peerage case*, which came before the House of Lords in 1825; and a full account of which has been published by Dr. Lyall. (Med. Ev. in Gardner Peerage case, 1827.) Alan Legge Gardner, the son of Lord Gardner by his second wife, petitioned to have his name inscribed as a peer on the Parliament roll. The peerage was, however, claimed by another person, Henry Fenton Jadis, who alleged that he was the son of Lord Gardner by his first and subsequently divorced wife. It was contended that the latter was illegitimate; and in order to establish this point, the evidence adduced was partly medical and partly moral. Lady Gardner, the mother of the alleged illegitimate child, parted from her husband, on board of his ship, on the 30th of January, 1802. Lord Gardner went to the West Indies, and did not again see his wife until the 11th of July following. The child, whose legitimacy was disputed, was born on the 8th of December of that year. Therefore the plain medical question was, whether a child born *forty-four weeks and four days* after intercourse, (from January to December,) or *twenty-one weeks and three days*, (from July to December,) could be considered to be the child of Lord Gardner. If this were answered in the affirmative, then it followed that this must have have been a very premature or a very protracted birth. There was no pretence that this was a premature case, the child having been mature when born. The question then was reduced to this—Was this alleged protracted gestation consistent with medical experience? Many medical witnesses, comprising the principal obstetric practitioners in the kingdom, were examined on this point. Their evidence was very conflicting, but a large majority concurred in the opinion, that natural gestation might be protracted to a period which would cover the birth of the alleged illegitimate child. On the moral side of the question, it was clearly proved that Lady Gardner, after the departure of her husband, was living in open adulterous intercourse with a Mr. Jadis, and on this ground Lord Gardner obtained a divorce from her after his return. He subsequently married a second wife, by whom he had the claimant, Alan Legge Gardner. It was contended that the other claimant was really the son of Lady Gardner by Mr. Jadis. The decision of the House was, that this claimant was illegitimate; and that the title should descend to the son of the second Lady Gardner.

The decision appears to have been chiefly based on moral circumstances; for had not the first Lady Gardner been living in open adulterous intercourse at the time of her husband's departure, it is highly probable, from the medical evidence bearing that way, that the legitimacy of the child would have been allowed. Again, supposing that the child had been born two or three weeks earlier, the question would have resolved itself into this—who had begotten the child?—the husband or the adulterer. This could not have been decided, and then, probably, as in the more recent case of *Anderton* v. *Gibbs*, (supra,) the course of law would have pronounced the husband to have been the father. The House then must have considered, that the medical opinions,

without cases to support them, could not be safely received. It is obvious that the possibility of gestation being protracted, must stop somewhere; and the Court probably, thought that they had here reached that point. Morally speaking, the decision could not be impugned; but medically speaking, it was incorrect; inasmuch as a Court of law never pretends to settle who begat a child, where the pregnancy might by any possibility be ascribed to the husband or an adulterer. The House of Lords, however, here decided that the adulterer begat the child; and by implication their decision involved this medical point,—that it is quite *impossible* the husband can be the father of a child born forty-four weeks and four days after access. A reference to Dr. Merriman's table, (antè, p. 537,) will show that this is a dangerous decision; for in four cases, this gentleman has known pregnancy to extend to the forty-fourth week, which would nearly cover the time here in dispute. But Dr. Beck, a physician of competent authority, has met with a case in which gestation was actually protracted to forty-four weeks and five days, i. e., one day longer than the period in the Gardner case. (antè, p. 537.) Supposing this case to be reheard, and the evidence of Dr. Beck called for, could the House vindicate its former decision? It would be found that they had pronounced to be impossible, what had actually come to pass; and either the decision would be the other way, or it would be contrary to that general rule of law, upon which so many decisions have been framed, that even although the wife may be living in adultery, the husband shall be presumed to be the father of her children, unless there is a proof of non-access—or absolute impossibility from the duration of the pregnancy. It is satisfactory to the majority of those who gave evidence in the Gardner case, to know that the conclusion to which they had come respecting the possibility of gestation being protracted to forty-four weeks and upwards, has been since confirmed by the occurrence of a well-marked case. The decision of the House of Lords, admitting that it was consistent with justice in this instance, can, it appears to me, only be defended on the principle, that when a married woman has had intercourse about the same period with her husband and an adulterer, her offspring should be bastardized on the mere proof of her adultery. Would Courts of law always act on this principle?

I have lately been informed of a much more difficult case, where the child whose legitimacy was disputed, owing to the mother living at the time in adulterous intercourse, could only be the offspring of the husband on the assumption of its having been born at the *seventh month* or the *tenth month*. The accoucheur made no particular observation respecting the child,—a sort of presumption against its being a seven months' child,—the undeveloped characters of which would hardly have escaped his observation. Therefore the case was reduced to this, that the offspring of the female might have been the nine months' child of the adulterer or the ten months' child of the husband. Could the one be, medically speaking, distinguished from the other? The answer, it appears to me, must be in the negative:—the legitimacy could only be decided by a consideration of moral circumstances; and if the Gardner case were allowed to form a precedent, and adulterous intercourse were clearly proved, it would be ruled against the legitimacy; because the question would not be whether the child could *by any possibility be* the offspring of the husband, for the affirmative of this was established in the Gardner case,—but whether under all the circumstances, it was not likely that the child had been begotten by the adulterer. It is a dangerous principle to settle who begat a child, but extreme cases call for extreme rules; and this is the only way

in which the decision in the Gardner Peerage case admits of an explanation.

The following case (*Luscombe* v. *Prettyjohn*, Exeter Summer Ass. 1840) will show how unsettled, legal opinions are upon these points; and that disputed questions of gestation are sometimes decided without medical evidence; although there are few instances in which it is more urgently required.

An action was brought against the defendant, by a farmer, to recover compensation for the loss of his daughter's services. It was alleged that the defendant had seduced her, and that she was delivered of a child of which he was the father. He denied that the child was his, among other reasons, on the ground that it was born two hundred and ninety-nine days, or forty-two weeks and five days after intercourse. No medical evidence was called to show that gestation might be thus far protracted; but the judge in summing up, made the following observations: "Upon the evidence it was almost *impossible* that he (the defendant) was the father." "Supposing that she (the woman) were right, that would place the birth at nine calendar months three weeks and five days." [The last meeting between the parties was had on the 9th February, and the child was born on the 5th December, 1838.] After adverting to some medical authorities relative to gestation, he said: "He would rather believe that she had yielded to some other attempt on her chastity, than that so wide a departure from the usual course of nature had taken place!" The jury did not concur in this view, and they returned a verdict for the plaintiff, thereby pronouncing an opinion which is well borne out by medical experience, that the defendant might have been the father of the child, although *forty-two weeks and five days* had elapsed since the last access. (Lancet, Aug. 1840.) Had the verdict been the other way, there would have been fair ground, medically speaking, for a new trial; for the summing up was undoubtedly made on a mistaken view of medical doctrines. It amounted to this, that the chastity of every woman who bore a child in the forty-third week of pregnancy was to be impeached,—and that the legitimacy of every such child was to be set aside on bare proof of the fact; whereas, according to Dr. Merriman's table, out of one hundred and fourteen pregnancies—a limited number of cases—fifteen took place in the forty-second, and ten in the forty-third week! (See antè, p. 537.) This shows the risk to which the decision of such questions is exposed, when *medical* evidence is not called for on matters so strictly professional.

Great mistakes have arisen in the calculation of the period of gestation, by the use of the word month—some intending by this, lunar, and others calendar months. Nine lunar months would be equal to two hundred and fifty-two days, while the average of nine calendar months would be two hundred and seventy days—the latter period varying according to the particular months of the year over which the pregnancy might extend. To prevent such mistakes or that misunderstanding of evidence which has so frequently arisen, it would be advisable that medical witnesses should always express the period of gestation in weeks or days. It will be seen by the foregoing cases, that in these suits the general practice consists in establishing possibility of access on the part of the husband;—when this is proved, the medical question arises, whether the term of gestation falls within those limits assigned by the best medical experience. Legitimacy has been allowed where gestation was probably protracted to the *forty-third week*,

(*Anderton* v *Gibbs*, Vice-Chancellor's Court, Nov. 1834,) and it has been disallowed, where it was protracted to *forty-four weeks* and five days. (*Gardner Peerage case.*)

PATERNITY.—It has been stated that the law does not pretend to determine who begat a child when it is born during wedlock, and from circumstances might be the child either of the husband or an adulterer. But medical jurists have recommended that family likeness should be looked to on these occasions, not merely a likeness in feature and figure, but in gesture and other personal peculiarities which may have characterized the parent. These are called questions of *paternity:* they seldom occur, and when they do present themselves, the evidence thus procured, even if affirmative, is properly regarded as only corroborative. In the *Townshend Peerage* case, brought before the House of Lords in May, 1843, this argument of family-likeness was used and admitted by their lordships. The party, whose legitimacy was in question, was sworn by one of the witnesses to bear so strong a likeness as a child to the alleged adulterer, that he should have known him among five hundred children. The proceedings in the *Douglas Peerage* case (1767) also show that evidence of this kind is of some importance.

Two young men claimed the Douglas peerage after the death of their alleged parents, Sir John and Lady Douglas. The claim was disputed, on the ground that they were supposititious children. Much stress was laid in favour of their legitimacy, on the fact that they closely resembled—the one Sir John, and the other Lady Douglas. The resemblance was general,—it was evident both in their features, gestures and habits. Lord Mansfield, in delivering judgment, made the following remarks, which comprise all that can be said on the subject. "I have always considered likeness as an argument of a child being the son of a parent, and the rather as the distinction between individuals in the human species, is more discernible than between other animals. A man may survey ten thousand people before he sees two faces exactly alike, and in an army of a hundred thousand men, every man may be known from another. If there should be a likeness of feature, there may be a difference in the voice, gesture, or other characters; whereas a family likeness runs generally through all of these; for in every thing there is a resemblance, as of feature, voice, attitude and action."

From this account, it will be seen that evidence from family-likeness is not strictly medico-legal,—it can only be furnished by friends and relatives who have known the parties well, and are competent to speak of the facts from personal acquaintance with them. It will also be apparent that the affirmative evidence in such cases will be stronger than that which is negative; for it could hardly be inferred that a person was illegitimate, because he did not resemble his parent.

It has been supposed that a case of this kind, might present itself on the marriage of a widow soon after the death of her first husband. If a child were born after the lapse of ten months, it might be a question whether it were a child of the first or second marriage; and although

there may be no dispute concerning its legitimacy, yet it would be difficult to settle its *paternity*. Such a case appears hypothetical. In order that any doubt should exist, a widow must marry within, at the furthest, six weeks after the death of her first husband, or else the birth of the child would fall beyond the furthest limit of gestation so far as he was concerned. The customs of society are, however, a bar to such marriages; and admitting that a child was so born, that it might be the offspring of either husband, then the fact of its being born during the marriage of the second husband, would presumptively fix the offspring upon him, unless it could be shown that there was no possibility of access on his part. If there were a supposed greater likeness to the first than the second husband, still this would not be allowed to defeat the legal presumption of the real parentage of the child. Evidence much stronger than this would be required for such a purpose. (See Henke Zeitschrift, 1838, ii. 432.)

A singular case of bastardy is reported to have occurred in the Canton of Appenzell. The question was which of two persons, who had had intercourse with the same woman within *seventeen* days, was the father of the illegimate child borne by the woman. The Council to which the case was referred, gravely resolved to postpone their decision until the features of the child were so far developed, as to enable them to decide from *paternal likeness*. The equity of this difficult case would have been met by compelling each man to contribute to the support of the child! (Schneider's Annalen der Staatsarzneikunde, 1836. 1 B. S. 470.)

Parental likeness may be occasionally indicated by colour or peculiarities belonging to the varieties of mankind, as of the intermixture of a Negro or Mongolian with one of the Caucasian variety. In such a case the evidence afforded, becomes much stronger. In some instances, attempts have been made to fix the paternity of a child by the *colour of the hair*, but this evidence is far less conclusive, than that afforded by the colour of the skin. In the case of *Frazer* v. *Bagley*, (Feb. 1844,) the wife of the plaintiff was alleged to have had criminal intercourse with the defendant, and the two last children, were alleged to be the offspring of the latter. The plaintiff and his wife had dark hair, as well as all the children with the exception of the two last:—these had red hair, and it was further proved that defendant had red whiskers and sandy hair. No particular stress was laid upon this evidence, but it was received as a kind of indirect proof. But little confidence can be placed on facts of this description, since red-haired children are often born to parents who have dark hair; and in one case the children born in wedlock, were observed to have dark and red hair alternately. An opinion has existed that children conceived at or about the time of the menstrual discharge in females, have red hair!

Questions of paternity are involved in those relating to *affiliation*. A party may allege that he is not the father of a particular child, by reason of certain circumstances upon which a medical opinion may be required. The necessary transmission of gonorrhea or syphilis by in-

tercourse, may thus become a medical question. In September, 1844, a man was required, under the law of bastardy, to support two children alleged by a female to be his. The time of gestation was within the nine months. The accused denied that he had had intercourse with the deceased, or that he could have been the father, since he was at the time under medical treatment for the venereal disease. The questions may therefore assume this shape. 1. Are these diseases invariably transmitted by intercourse? 2. Do they interfere with the act of procreation? Under common circumstances they must both be answered in the negative.

CHAPTER L.

SUPERFŒTATION. IMPOTENCY. STERILITY.

Superfœtation.—Most medico-legal writers, in treating of legitimacy, have considered it necessary to introduce the subject of superfœtation. By this we are to understand, that a second conception may follow the first, and that gestation may go on to its full period in each case, independently of the other,—so that if a woman were impregnated, when in the third month of gestation, she would bear the first child mature at the end of nine months, and the second child also mature, at the end of twelve months after the first conception. This subject has been said to involve "not only the conjugal fidelity of a wife, but the disposition of property, and much of the comfort and happiness of society." Its importance to a medical jurist appears to me to have been here considerably exaggerated. So far as I have been able to ascertain, not only is there no legal case involving this question, to be met with in the judicial records of this country; but none in reference to this state, is ever likely to occur which would present the least difficulty to a medical practitioner. If we admit that a woman may during marriage, present such an extraordinary deviation from the common course of nature, as to produce two perfectly mature and full developed children, the one three or four months after the other, how can such an event be any imputation on her fidelity? Superfœtation, if it occur at all, may occur in married life, and during connubial intercourse. The following appears to be the only possible case wherein a medical opinion might be required respecting this alleged phenomenon. A married woman, six months after the absence or death of her husband, gives birth to a mature child, which dies. Three months afterwards, and nine months after the absence or death of her husband,

she may allege that she has given birth to another child also mature; a medical question may arise, whether two mature children could be so born, as that the birth of one should follow three months after the birth of the other,—or whether this might not be a case, by no means uncommon, of twin children, the one being born prematurely, and the other at the full period. Admitting that both the children were mature; and therefore that it was a case of superfœtation,—the first delivery must have taken place in the presence of witnesses,—and it would then have been known whether another child remained in the uterus or not. If the two children were born within the common period of gestation after the absence or death of her husband, then their legitimacy would be presumed, until the fact of non-access were clearly established. The mere circumstance of both of them being apparently mature, and born at different periods would per se furnish no evidence of their illegitimacy. On the other hand, if one or both of them were born out of the ordinary period, then, according to the evidence given, they might or might not be pronounced illegitimate. The law therefore appears to have no sort of cognizance of the subject of superfœtation as such: it is entirely merged in the question of protracted gestation, which has already been fully considered.

Whether superfœtation can really take place or not, is a question which has given rise to much controversy. That one conception may follow another within a short period, and that twins may thus be the result of two distinct conceptions, is a probable occurrence. This indeed is what may be termed *super-conception*. But when gestation has already gone to the second month, it is highly improbable that there should be a second conception. In one case, however, where two men had intercourse with the same female within the period of seventeen days—a case favourable for super-conception, there was only one child and the paternity was disputed. (See ante, p. 543.) Cases of alleged superfœtation appear readily explicable on the supposition that the woman was pregnant with twins, and that one was born prematurely, and the other at the full time, or later. For an instance of this kind, see Henke Zeitschrift der S. A. 1837. Even under a malformation which might be supposed to be favourable to its occurrence, namely, the presence of a bilocular uterus, it has been found that impregnation has sometimes taken place in one cornu only. (See Med. Gaz. xix. 507.) A singular instance is, however, recorded in the same journal (xx. 508), where a woman six months after marriage, bore a four months' child, and forty weeks after marriage, mature twins. On examination, the uterus and vagina were both found double—each vagina had a separate orifice.

IMPOTENCY.—We have hitherto considered the subject of legitimacy in reference to the duration of gestation; but we have now to examine those cases in which the plea is, that the alleged parent laboured under physical incapacity. This may depend on age, on certain physical causes, or on congenital malformation or defect. To this condition, the term IMPOTENCY is applied in the male, and STERILITY in the

female. We may first consider the causes to which *impotency* may be referred.

I. AGE.—The person may be so *young* as to render it impossible that he should be the father of a child imputed to him. Cases involving questions of legitimacy on this ground, are not heard of in the present day; but in ancient law-books there are decisions relative to the illegitimacy of children, born during marriage, because the alleged fathers were seven, six, and even three years old! (Amos.) The exact age at which the sexual function appears, differs in different individuals; —it is usual to say, that it does not exist until after the age of puberty (14), but this state does not always occur at the same period. A question relative to the virile power of individuals at this early age, may be put to a medical witness in reference to the affiliation of children. The following case occurred in 1840. A woman wished to affiliate a child on a youth, who was in his sixteenth year. The boy denied that he was the father of the child; and there was reason to suspect that the imputation had been wrongly thrown upon him, in order to divert suspicion from the real party. There was some difficulty in the case: but it appears to me that the rule for a medical man to follow on these occasions is this:—not to regard the mere age of the youth, whether he be above or below the average age of puberty, but to observe whether the sexual organs be fully developed, and whether there be about him any of the ordinary marks of virility, indicated by muscular development, the growth of a beard and a change in the voice. If these signs be present, whatever may be his age, there is strong reason to suppose that the sexual functions are developed. We occasionally hear of instances of extraordinary precocity; but the development of the sexual power is generally accompanied by other well-marked changes in the individual. One singular instance to the contrary is mentioned by Botta. (Athenæum, 1842, p. 3.)

On the other hand, it may be alleged, that the individual was so *old* that he must have been necessarily impotent through age. That impotency is one of the natural consequences of advanced age, is undoubted: but this, as we know, forms no legal impediment to the marriage of parties however old. The legal presumption is, that the generative faculty does not disappear through age; and if this be alleged, and legitimacy disputed on this ground, it must be satisfactorily proved. This amounts almost to an impossibility; because it is well known, that there is no particular age at which the sexual functions disappear either in the male or female; and individuals of both sexes who had passed the ages of sixty, seventy, and even eighty years, have been known to be prolific. In relation to this question, it may be mentioned as an interesting physiological fact, that Mr. Curling found spermatozoa in the liquid taken from the testicles of a man upwards of seventy years of age, and on one occasion in the testicles of a man aged eighty-seven. (Med. Chir. Rev. April, 1844.) The English law on this subject, was clearly laid down in the *Banbury peerage case*, brought before the House of Lords many years since. Lord and Lady

Banbury had been married twenty-one years without having had issue, when his lordship died at the age of eighty years. The peerage was claimed by an individual, who called himself the son of Lord Banbury; but in fact it was alleged, that he was the son of Lady Banbury by an adulterer, during her husband's life. According to the evidence, Lord Banbury did not appear to be aware of his existence; and the child had always been known by another name. One of the grounds upon which the legitimacy of the descent of the claimant was contested, was, that the deceased nobleman was impotent through age; but it was then stated on good legal authority, that the law put no limit on the powers and faculties of man. The assumed impotency of the alleged parent on the ground of age, could never be admitted as a proof of the illegitimacy of the supposed offspring. The House decided against the claim, but not on the ground of impotency from age in the supposed parent. (See also Henke Zeitschrift, der S. A. 1842. ii. 162, 330.) Impotency may depend on *moral* causes, or on latent physical causes only discoverable after death, but with these a medical jurist has no concern; the law requires clear proof of the existence of some apparent and irremediable defect, in order to interfere in questions relative to legitimacy or divorce.

II. Disease, or accident.—The loss or destruction of any of the external organs, either by disease, accident, or from necessary operations, would be a sufficient ground to allege impotency. The loss of one or both testicles from any of these causes, would be indicated by the presence of distinct cicatrices in the scrotum. The loss of one testicle only does not render a man impotent;—*Monorchides* have been known to be prolific. Cases of this kind must not be confounded with those, in which one or both testicles have never descended into the scrotum. In some rare instances, the organs do not descend at the usual period; but one or both may remain in the abdomen, or in the inguinal canals, and only descend some time after birth,—or one may be found in the scrotum, and the other remain in the abdomen. In this case they have been mistaken for, and treated as herniæ by the application of a truss! (Henke Zeitschrift, der S. A. 1844. i. 249.) When one of the organs only has descended, there is no ground cæteris paribus to impute impotency. When neither has descended, the scrotum will be found empty, but all the other marks of virility may still be present. It has been said that in such cases, the testicles were congenitally defective, but this is an error. Dissection has clearly proved that they have merely not descended; and although remaining in the abdomen, there was no reason to believe that they were incapable of exercising their functions. This absence of the testicles is a state very rarely seen: there are three preparations of this kind in the museum of Guy's Hospital,—one of them taken from a gentleman who shot himself out of despondency at his supposed defective condition. These individuals have been called *Crypsorchides*. Hunter thought the undescended testicles were imperfect, both in

their organization and functions, and that crypsorchides were impotent. But the recent researches of Mr. Curling and others, have shown that there is no foundation for this opinion. My friend, Mr. Cock, informs me that he has notes of the cases of two men, whose testicles had not descended, and in whom the virile functions were perfect. One of them, who is now not more than thirty years of age, has already married twice, and had children by each wife, besides having illegitimate children affiliated on him at the time he lived in service! In general it will be found that the usual signs of virility have appeared about the person. If, in a case of non-descent, there should be a non-development of the external organs, and this is accompanied by a total want of the characters of virility, no doubt can be entertained, that the individual is irremediably impotent. In cases of *Epispadias* and *Hypospadias*, the power to have fruitful intercourse, must depend on the situation of the urethral aperture. Impotency may arise from disease, such as large irreducible herniæ, and the medical opinion here must be regulated entirely by the circumstances attending each case.

III. Congenital defect, or malformation.—To this condition, the term hermaphroditism has been applied: it should rather be called sexual malformation or monstrosity. Owing to arrested development, during the growth of the fœtus, the sexual organs, which can scarcely be distinguished at the fourth month, occasionally assume a certain abnormal arrangement. The sexes appear to be more or less mixed, and sometimes the male, and at others, the female characters predominate. In the former case, these beings are called androgyni, and in the latter androgynæ. With this defective sexual development, the other peculiarities of the sexes are either wanting, or we find them more or less blended. Thus, in an *androgynus* the general figure of the body may be that of a female,—the male voice is wanting, and there is no beard; —on the other hand, in the *androgyna*, there may be a predominance of the male characters. There can be no difficulty in identifying such cases, and a medical jurist can have no hesitation in pronouncing these subjects to be incurably impotent,—the organs are commonly so defective as to be wholly unfitted for the functions of either sex. It is not meant to be said, that it is in all cases easy to assign the sex, but this is of minor importance;—the main question is, whether the malformation be or be not such as to justify divorce, or the imputation of illegitimacy upon children claiming to be the offspring of these beings. One of the most remarkable of these sexual monsters, died in 1835, at the age of 55, and was examined by Prof. Mayer of Bonn. In general there is defective development of either the male or the female organs, but in this case there was a real approach to hermaphroditism;—the defective sexual organs on the right side, belonging to the male, and those on the left belonging to the female! The general configuration of the body was that of a woman. (See Med. Gaz. xix. 135.) For some interesting observations by Dr. Knox on this subject, see the

same journal for Nov. and Dec. 1843, et seq. The determination of the *sex* in these cases of *deformity* has been considered to be necessary under certain circumstances, as when, for instance, a title or entailed inheritance of lands is in question. Lord Coke has stated, that according to the law of England, an hermaphrodite may be either male or female, and it shall succeed according to the kind of sex which is predominant. Thus it is obvious, that the law will decide each case according to the special circumstances attending it. Sexual monstrosity, although it may lead to suits of divorce and legitimacy, is not a ground for depriving the being of the rights of inheritance. According to Chitty (M. J. 373) the calling a person an *hermaphrodite* is not actionable, unless it is proved to have been attended with some special damage. A case was tried, in which a dancing-master brought an action against a party for calling him an hermaphrodite; and it was decided that it was not sustainable: 1. Because such union of the sexes cannot exist in fact, and every one must be supposed to know it;—consequently the assertion could not be supposed to prejudice. 2. Because, admitting the possibility of such double function, the party would be just as good and perhaps even a safer dancing-master, than if only one perfect sex had been discoverable—consequently the words would not, in legal presumption, injure him in his profession or occupation! In the *Townshend peerage case,* lately decided (1843) the legitimacy of one claimant was denied on account of the impotency of the alleged parent, whether from congenital defect or otherwise, no evidence was given to show. The illegitimacy was established by proof of non-access on the part of the husband, without reference to his alleged impotency.

Sterility.—The causes of sterility in the female system are very numerous. Some of them depend upon peculiarities of constitution, the sexual organs being well formed and developed,—others upon latent changes or congenital defects in the uterus and its appendages, only discoverable by an examination after death. This condition of the female rarely becomes a medical question in contested cases of legitimacy; for a claim on the part of an individual to be the offspring of a particular woman, unless the female herself were in collusion with the claimant, could only be made after her death; and if not disproved by medical evidence, showing that the woman could not have borne children, it would in general be easily set aside by circumstances. If the uterus, ovaries, or other parts, were congenitally absent, or if there were external sexual malformation, accompanied by occlusion or obliteration of the vagina, a medical witness could have no difficulty in saying that the woman must have been sterile. A mere occlusion of the vagina, removable by operation, does not always indicate sterility, for the internal parts may be healthy and sound. In some instances, the uterus may be entirely absent, a fact which cannot be always determined during life. On the whole, the physical and irremediable causes of sterility in the female, are not so apparent as in the male;

because in the former, the generative apparatus is placed internally; and slight changes in its various parts, sufficient to produce permanent sterility, cannot be determined by an examination.

With respect to AGE.—The sexual functions in a female are regulated by the catamenia, so that it is commonly asserted that females cannot become impregnated either before or after these have ceased to appear. As a general principle, this may be true; but a case has been elsewhere related (PREGNANCY, antè p. 499), where a woman became pregnant who had not up to that time menstruated; and in another instance, a woman aged 44, in whom the discharge had entirely ceased for seven months, became pregnant. Some females are very precocious, and may conceive at a very early period of life; but then it will commonly be found that the menses have appeared early. in some rare cases, however, conception has preceded menstruation. Others will bear children at the age of sixty, and upwards—in short: as it has been already stated of impotency in the male, sterility cannot be presumed to exist from mere age.

Count Strzlecki has lately announced the singular fact, that sterility may be acquired with respect to particular males, (*sterilitas versus hunc*),—a condition which is the converse of the old and exploded doctrine of *impotentia versus hanc.* He alleges from numerous observations, that the females of aboriginal tribes, when they have once borne a child to a European or white, become sterile and cease to procreate with males of their own race. (Phys. History of N. S. Wales, 1845.)

There is another point of view in which these defective states of the sexual organs may come under the consideration of a medical jurist, namely, where they are made grounds for a *divorce.* To justify this, the impediment to intercourse or procreation must be apparent and irremediable; it must also have existed before the marriage of the parties, and have been entirely unknown to the person suing for the divorce. The nature of the impediment is commonly determined by private medical opinions or affidavits. A divorce granted under these circumstances is total, i. e. "*a vinculo matrimonii.*" There is one remarkable circumstance with respect to these cases, namely, that in nearly all of them, the suit is by the female against the male; although there is no reason whatever to suppose that impotence and sexual malformation, are more common in males than sterility in females. We never hear of a man instituting a suit of divorce on the ground of sterility in the wife; it is, I believe, in most instances, that the wife promotes the suit on the ground of impotency in the husband. The difficulty of establishing sterility, and the facility of proving impotency in many cases, may account for the difference. Suits of this kind are sometimes instituted many months and years after the union of the parties; but it is pretty certain that the desire for separation in these cases, often depends on some other cause which the law would not recognize as sufficient of itself, while it would admit the plea of impotency. The French law very judiciously applies the

principle of condonation to such cases, so that no suit for nullity of marriage can be entertained, if cohabitation have continued for six months after the discovery of the personal defect. This appears to be more consistent with justice, than that of our own law: but practically these suits after protracted cohabitation, are regarded with much suspicion. The nature of the medical evidence required on these occasions, will be best understood by the following extract from Oughton:—"Ad probandum defectus judex compellere potest virum ad exhibendum præsentiam suam et ad ostendendum in aliquo loco secreto (per judicem assignando) pudenda sua, seu illos corporis defectus quos mulier objicit (si ex inspectione corporis apparere possint) medicis et chirurgis peritis prius judicialiter in præsentiâ partis adversæ de diligenter inspiciendo virum et de referendo in scriptis eorum judicium juratis. Et si medicorum et chirurgorum judicium sit quod morbus vel defectus viri fuerit insanabilis et incurabilis (tamen tenentur in relatione eorum judici ipsum morbum seu defectum specificare ne circumveniatur Ecclesia) et quod in eorum scientiâ, doctrinâ, experientiá morbus aut defectus hujusmodi nullâ re aut arte medicâ curari possit mulier obtinebit in causâ: Hoc addito et allegato ex parte mulieris, quod ipsa sit juvenis et ad procreationem apta et quod per tres annos insimul pernoctarunt et quod quamvis a marito cognosci cupiebat, ab eo tamen cognita non fuit nec cognosci potuit!" A case of this kind came before the Vice-Chancellor's Court, in February 1845, (*Wilson* v. *Wilson*,) in which the female produced medical certificates to prove that she was "virgo intacta!" There is only one observation to be made respecting these certificates. Females have become pregnant with what is commonly regarded as the chief sign of virginity intact. (See post, p. 557.) Indeed the division of the hymen has been rendered necessary for the delivery of the child. Negative evidence of non-consummation from the physical condition of the female, is therefore of less value than the affirmative evidence from the existence of a physical defect in the male.

RAPE.

CHAPTER LI.

SIGNS OF RAPE. DEFLORATION. MEDICAL PROOFS.

Rape is defined in law to be the carnal knowledge of a woman by force and against her will. It was formerly a capital crime, but transportation for life was substituted for capital punishment by 4 and 5 Vic. c. lvi. s. 3. This crime has been on the increase of late, for it is stated that on the average of the last four years rapes have increased 57 per cent. (Law Times, January 4, 1845.) Medical evidence is occasionally required to support an accusation of this kind, but it is seldom more than corroborative, because the facts are in general sufficiently apparent from the statement of the prosecutrix. There is, however, one case in which medical evidence is of some importance, namely, where a false accusation is made. In some instances, as in respect to rape on young children, the charge may be founded on mistake; but in others there is little doubt that it is often wilfully and designedly made for motives, into which it is here unnecessary to inquire. Professor Amos remarked some years since, that for one real rape tried on the circuits, there were on the average twelve pretended cases! In some few instances, these false charges are set aside by medical evidence:—but perhaps in the majority, they are developed by the inconsistencies in the statement of the prosecutrix herself. The duty of a medical witness on these occasions is very simple; and perhaps, this will be best understood by considering the subject under the following heads. It may be observed, that the consent of the female does not excuse or alter the nature of the crime where she is under ten years of age, since consent at this period of life is invalid; and the carnal knowledge of the female is rape in law. Even the solicitation of the child does not excuse it. Medical evidence in rape may be derived from four sources. 1. Marks of violence about the genitals. 2. Marks of violence on the person of the prosecutrix or prisoner. 3. The presence of certain stains from the spermatic fluid on the clothes of the prosecutrix or prisoner. 4. The existence of gonorrhea or syphilis in one or both. This evidence will vary according to the following circumstances.

On young children.—The sexual organs should in these cases present traces of injury if there has been any resistance whatever on the part of the child; for it is impossible to conceive that any forcible intercourse should have taken place without the production of ecchymosis, the effusion of blood or the laceration of the pudendum. It has been propounded as a serious question, whether a rape can be perpetrated on a child of this age by an adult man; and medical witnesses at trials have been found to adopt diametrically opposite views on this point. For the legal establishment of the crime, proof of penetration only is demanded, and it would appear from one decision at least, (*Rex* v. *Russen,*) that a degree of penetration so slight as not to injure the hymen, would be sufficient to complete the crime. In the case alluded to, the hymen of the child was proved to be entire, and under the direction of the judge, the prisoner was convicted and executed. This trial took place in 1777; but since that period, one judge, the late Baron Gurney, has ruled the contrary. He held in one case that there must be a sufficient penetration of the male organ to rupture the hymen; and unless this membrane were found ruptured, the offence would not be complete in law. (*Rex* v. *Gammon,* Archbold, Crim. Plea. 406.) According to this decision, the duty of a medical man would simply consist in determining whether the hymen was entire or not. It is, however, hereby left uncertain how those cases would be disposed of, where the hymen had been destroyed by disease, or was congenitally absent, or where, as in a case which was lately tried, the hymen was only partially ruptured. But it is more than doubtful, whether our judges would adopt this view; they would most probably require a medical opinion, whether there might not be some degree of penetration,—as into the vulva, without necessarily rupturing that membrane, and upon this point there appears to me, medically speaking, to be no doubt:—further, this penetration might take place without leaving any extensive marks of violence about the pudendum. Of course it would be only proper where the physical injury was so slight, to require good corroborative evidence, and in the absence of this evidence, the prisoner would probably be convicted only of the assault with intent. It must not be assumed by medical witnesses that all these charges of rape on young children are frivolous, and that they impute an impossible crime. Medically speaking, some penetration may take place without a necessary destruction of the hymen; and morally speaking, the crime must be the same, whether the membrane be ruptured or not; for how is it possible to repress, what society agrees in regarding as a very heinous offence, if medical witnesses are to be allowed to dispute about degrees of penetration for its completion? It is doubtful whether in any case, there could be a complete introduction of the male organ into the vagina, without laceration and destruction of the soft parts; but are we to be told upon medical grounds, that no offence analogous to rape can possibly be perpetrated on female infants, unless such marks of physical injury be invariably present? This is making the proof of the carnal abuse of such children

to depend upon mere accident. It is laying down a rule that penetration to the vulva shall not constitute rape, while penetration to the vagina shall be visited by the usual punishment. The law however, would not sanction this view; for on no pretence could a different punishment be assigned to the two acts. The moral injury to the female and to the laws of society, is the same in the two cases.

In a case lately brought before a magistrate, the evidence left no doubt that the crime had been committed on the person of a young girl about ten years old. The surgeon stated that there were considerable marks of violence about the pudendum, but completion (i. e. penetration) was, in his opinion, physically impossible, in a child under ten years of age. Upon this evidence, the charge of felony was abandoned. In the following case, the child was older; but the facts bear immediately upon the question which we are here discussing. It was tried at the Central Crim. Court, March 1843: and the particulars were communicated to the profession by Mr. Adams, of the London Hospital, (See Lancet, March 25, 1843.) A man was charged with a rape upon his own child, aged fourteen. Mr Adams examined the child about two days after the alleged perpetration of the crime; and he found no injury about the vulva or adjacent parts, and the hymen was unruptured. He gave a positive opinion at the trial, that no rape had been committed. Two other medical witnesses, men of experience and integrity, stated their belief that the crime had been perpetrated. It appears that they had examined the child soon after the alleged offence, and a day or two before Mr. Adams. The prisoner was acquitted of the rape, but found guilty of the assault. The absence of any marks of injury about the vulva, so short a time after the alleged criminal act, and the fact of the hymen being unruptured, in some measure justified the opinion of Mr. Adams, that there was no medical proof of a rape having been committed. At the same time he candidly restricts his opinion, by saying that if by rape we are to understand penetration to the vulva, then was it effected; but there was no evidence to show vaginal penetration:--on the contrary, the unruptured state of the hymen in a forcible intercourse was against the view. The only remark which this case requires, is that the statute law says nothing about the rupture of the hymen as part of the evidence: it merely requires proof of penetration. This may occur and the hymen remain intact. Under these circumstances we shall probably find different judges taking different views of the degree of penetration required; although one cannot perceive that the offence is morally or legally lessened by the fact of the penetration having been so slight as to leave the hymen uninjured.

When, as in the case just related, there are no marks of violence or physical injury about the pudendum of a young child, whether because none originally existed, or they had existed and disappeared in the course of time, a medical witness must leave the proof of rape to others. He can only answer questions of possibility or probability, according to the special facts proved. On the other hand, if marks of mechanical violence are present, they must not always be hastily assumed as furnishing proof of rape; for cases are recorded, where such injuries have been purposely produced on young children, as a foundation for false charges against individuals. The proof or disproof of facts of this kind, must rest more upon general than on medical evidence, unless the injuries obviously indicate the use of some weapon or instrument. It should be remembered that the hymen is not always present in young children:—it may be according to some, congenitally defi-

cient, or, what is more probable, it may have been removed by ulceration or suppurative inflammation of the parts, a disease to which female infants of a strumous habit are very subject. The mere absence of the membrane therefore, can afford no proof of the perpetration of the crime, unless we find traces of its having been recently torn by violence.

The existence of a purulent discharge from the vagina has been erroneously adduced as a sign of rape in these young subjects. The parents or other ignorant persons, who examine the child, often look upon this as a positive proof of impure intercourse; and perhaps lay a charge against an innocent person who may have been observed to take particular notice of the child. Some cases are reported, by which it would appear that individuals have thus narrowly escaped conviction for a crime which had really not been perpetrated. If the child be labouring under syphilis or gonorrhea, this is positive evidence of impure intercourse either with the ravisher or some other person, but we should be well assured, before giving an opinion, that the discharge is really of a gonorrheal, and not simply of a common inflammatory character. The party accused might be at the time free from that disease, or if labouring under it, then we should expect that the discharge suddenly made its appearance in the child with the usual severe symptoms, at a certain interval of time after the presumed intercourse, i. e. about the third, fourth, or fifth day. When these conditions do not exist, it is extremely difficult to form a medical opinion on the subject, since there are no means of distinguishing sporadic discharges from those which are gonorrheal. Under these circumstances, proof must be derived from non-medical sources. With respect to marks of violence on the body of the child, these are seldom met with, because no resistance is commonly made. Bruises or contusions may occasionally be seen on the lower extremities.

Some of the facts connected with rape on young children, were brought out in the case of the *Queen* v. *Mosely*, tried at the Cent. Crim. Court, Sept. 1843. The prosecutrix was a child between twelve and thirteen years of age, and she charged the defendant with having committed a rape upon her, alleging that she made all the resistance in her power. Dr. Merriman stated that he examined the prosecutrix two or three days after the alleged offence was committed; but could not give any decided opinion on the case, although there was every appearance of violence having been used. Another medical witness stated that the prosecutrix had been under his care for the last eight or nine days for a disease, (gonorrhea,) with which, in his opinion, she had been infected for a considerable time; and a third proved that the prisoner was not infected with this disease. Dr. Merriman, however, is reported to have said that the prosecutrix was not labouring under the disease when he examined her. It is difficult to explain how this descrepancy on a matter of fact of some importance, could have arisen. The jury acquitted the prisoner, probably not trusting to the statement made by the prosecutrix.

In the case of *Reg.* v. *M'Donough*, (Cent. Crim. Court, Oct. 1843,) Mr. French and Mr. Tucker deposed that the gonorrhea under which the prosecutrix (æt. 15) laboured, had probably not existed longer than a week,—it might have been of longer standing, but it certainly could not have existed for six weeks, the date at which it was alleged that the rape was perpetrated by the prisoner, and the disease communicated. Upon this evidence, the prisoner was acquitted.

On young females after puberty.—When the crime is committed on a female from the age of ten to twelve years, the facts are much the same as those already referred to with respect to children below the age of ten years. There is, however, some difference in the legal complexion of the offence. If carnal intercourse be had with the consent of a female between the ages of ten and twelve years, the offender is guilty of a misdemeanour only. Above the age of twelve years, the consent of the female does away with any imputation of legal offence. Females who have passed this age, are considered to be capable of offering some resistance to the perpetration of the crime; and therefore in a true charge, we should not only expect to find marks of violence about the pudendum, but also injuries of greater or less extent about the body and extremities. It is likely in these cases, if the charge were well founded, that the hymen would be ruptured, as the intercourse is presumed to be violent; but there might be some degree of penetration without this being a necessary result, especially if the membrane were placed far up. At any rate a young female at this age may sustain all the injury, morally and physically, which the perpetration of the crime can possibly bring down upon her, whatever may have been the degree of penetration; and for this reason, it is laid down in our law, that the crime consists in the mere proof of penetration. The fact is, however, in general clearly made out by the statement of the female. With respect to marks of violence on the person, the exact form, position and extent of these should be noticed; because a false accusation of rape may be sometimes detected by the violence being in a situation in which it was not probable that the ravisher would have produced it. When bruises are found, the presence or absence of the usual zones of colour may occasionally throw light upon the time at which the alleged assault was committed. These marks of violence on the person, are not likely to have been produced with the concurrence of the female. They are therefore considered to furnish some proof of the intercourse having been against her will. But the physical appearances of rape about the pudendum may be found, whether the connection has been voluntary or involuntary. Thus rupture of the hymen, swelling and inflammation of the orifice of the vagina and stains of blood, may be met with in both cases. Unmarried females of the age here supposed, are liable to purulent discharges from the vagina, under which the hymen may be destroyed. At a more advanced age, they are frequently subject to leucorrhea. These cases are not likely to be mistaken for gonorrhea; as here the female has it in her power to give some account of the circumstances, from which a medical opinion may be easily formed.

Here it will be necessary to say a few words respecting the *signs of virginity*, a subject upon which in some medico-legal works, a great deal of poetical discussion appears to me to have been wasted. Independently of cases of rape, this question may occasionally assume a practical bearing in relation to the signs of DEFLORATION. In civil cases a medical witness may be asked whether a particular female has ever had inter-

course or not. Proof of this fact may be necessary, to rebut or substantiate statements made in evidence. The question may be not whether the female has had a child or not, for this would resolve itself into the proof whether delivery had or had not taken place :—it may be limited to the probability or possibility of intercourse on her part, at some antecedent period. Now a medical jurist, when consulted in such a case, can only be guided by the external signs of virginity. The hymen may be intact, but this does not prove non-intercourse, because females have been known to conceive with the hymen uninjured; and an operation for a division of this membrane has been frequently necessary before delivery could take place. (Henke's Zeitschrift, der S. A. 1843, ii. 149.) This might be explained by the membrane being hard and resisting, and at the same time small in extent, i. e. only partially closing the vagina. Under opposite conditions, the persistence of this membrane, might fairly lead to the inference that the female was chaste, and that there had been no intercourse. When the membrane is destroyed by disease or other causes, or when it is congenitally absent, the opinion must be more or less conjectural; for one intercourse could hardly so affect the capacity of the vagina, as to render the fact evident through life, and there is no other datum upon which a medical opinion could be based. The presence of the hymen, is of course quite incompatible with the assumption that the female has borne a child. A question of this kind incidentally arose in the case of *Frazer* v. *Bagley* (Common Pleas, Feb. 1844). It was alleged by defendant, that the plaintiff, a married man, had had adulterous intercourse with a young female, and that at an antecedent period she had left her home for the purpose of giving birth to a child privately. Dr. Ashwell was called upon to examine the party, and he deposed that in his opinion, the female was a virgin, and had never had a child. (See also Henke, 1844, i. 259.)

On the married.—The remarks already made, apply here with this difference, that where the female has already been in habits of intercourse with the other sex, there is commonly much less injury done to the genital organs. The hymen will, in these cases, be found destroyed and the vulva dilated. Still as the intercourse is presumed to be against the consent of the woman, it is most likely that under proper resistance, some injury will be done to the pudendum, and there will be also, most probably, extensive marks of violence on the body and extremities. Such cases are generally settled without medical evidence from the statement of the female alone, corroborated as it should be, by circumstances. When a charge of this kind is made by a prostitute, it is very justly received with suspicion, and the case is narrowly scrutinized. Something more than medical evidence would be required to establish a charge of rape under these circumstances. The question turns here, as in all cases of rape upon adult females, on the fact of *consent* having been previously given or not. This is the point at which the greater number of these cases of alleged rape break down;

and it need hardly be observed, that this question has no relation to the duties of a medical witness:—all that he can do is to establish occasionally, whether or not sexual intercourse has been had with or without some violence. It is obvious, that there may be some marks of violence about the pudendum or on the person, and yet the conduct of the female may have been such as to imply consent on her part. We must not suppose, as it appears to be commonly done, that medical proof of intercourse is tantamount to proof of rape.

Some medical jurists have argued, that a rape cannot be perpetrated on an adult female of good health and vigour; and they have treated accusations made under these circumstances, as false. Whether on any criminal charge, a rape has been committed or not is, of course a question of fact for a jury, and not for a medical witness. The fact of the crime having been actually perpetrated, can alone be determined from the evidence of the prosecutrix and other witnesses. Still a medical man may be able to point out to the Court, circumstances which might otherwise escape notice. Setting aside the cases of infants, lunatics and weak and delicate females, it does not appear probable that intercourse could be accomplished against the consent of a healthy adult female, except under the following conditions: 1. When narcotics or intoxicating liquids have been administered to her, either by the prisoner or through his collusion. It matters not in a case of this kind whether the narcotics have been given merely for the purpose of exciting the female, or with the deliberate intention of having intercourse with her while she was intoxicated,—the prisoner is equally guilty. (See *Reg.* v. *Camplin*, Law Times, June 28, 1845.) The case is, however, different in natural sleep. A man was recently charged with rape before a police magistrate, and the prosecutrix swore that he had effected his purpose during her sleep. The bare possibility of the offence being perpetrated under these circumstances cannot be denied, but this would only apply to a case where the sleep was preternatural or lethargic. In this instance, the female was a prostitute, and the charge improbable: all such cases can only be determined by the special facts accompanying them. 2. When a woman falls into a state of syncope from terror or exhaustion. 3. When several persons are combined against the female, in which case we may expect to find considerable marks of violence about her person. 4. A woman may yield to a ravisher, under threats of death or duress,—in this case her consent does not excuse the crime, but this is rather a legal than a medical question.

It is necessary to observe in relation to the examination of females, that the marks of rape, however strong in the first instance, soon disappear or become obscure, especially in those who have been already habituated to sexual intercourse. After two, three or four days, unless there has been a very unusual degree of violence, no traces of the crime may be found about the genital organs. In unmarried females and in children, where there has been much violence, these marks may persist and be apparent for a week or longer. Supposing at the period of examination, no such marks exist, it may be necessary

to consider whether there has been time for them to disappear since the alleged perpetration of the offence; but it is rarely in a witness's power to express an affirmative opinion of the perpetration of the crime; he must leave this to be proved by the general and circumstantial evidence. Marks of violence on the person can never establish a rape; they merely indicate, cæteris paribus, that the crime has been attempted.

Of late years, it has been proposed to add to the medical evidence in rape, the examination of *spots or stains* on the linen of the prosecutrix and prisoner. (Ann. D'Hyg. 1834, 210. 1839, 134.) Thus, it has been recommended to infuse the stained linen in water, and examine the liquid with a good microscope, in order to observe whether it contains *Spermatozoa*,—long slender eel-like animalcules, which are known to exist in the healthy spermatic secretion. Cases of rape have hitherto been tried in this country, without reference to this species of evidence: nor is it easy to perceive, how this can be necessary to the proof of the crime, when the present law of England demands only proof of penetration and not of *emission*. Thus, a rape may be legally completed without reference to emission; and medically speaking, it appears quite possible, that there might be emission without any penetration. Admitting that certain stains of this description are found on the clothes of an accused party,—Is this to be taken as undeniable proof of the legal completion of rape? It appears to me that it cannot be so taken, and therefore the affirmative evidence from the microscope, under these circumstances, is as liable to lead to error as that which is purely negative. The fact that spermatic stains are found on the linen of the prosecutrix, may however become occasionally of some importance, as the following case, which was tried at Edinburgh Nov. 27, 1843, will show. A man labouring at the time under gonorrhea, was charged with a criminal assault on a child. The shift worn by the prosecutrix, with other articles belonging to the prisoner, were submitted to Mr. Goodsir and Dr. Simpson for examination. Some of the stains on the linen were of a yellow colour, and were believed to be those of gonorrhea,—others characterized by a faint colour and a peculiar odour, were considered to be stains caused by the spermatic secretion. Digested in water, they yielded a turbid solution of a peculiar odour; and when submitted to a powerful microscope, spermatozoa were detected. The majority of them were mutilated, the tails being broken off; but perfect specimens were seen, which differed from the living animalcules only in being motionless. The stains were similar on the linen of the prisoner and the prosecutrix. The prisoner was convicted of an assault with intent to ravish, and transported for fourteen years. (Cormack's Edinburgh Journal, April 1844.) I believe this to be a solitary instance of the use of the microscope for such a purpose in this country. It has been intimated to me by a friendly critic, that it should have modified the opinion expressed on this kind of evidence, in the first edition of this work. The only obstacle to the adoption of this advice, was that the case was not tried, and therefore the evidence was not given until a month after

the volume had been printed off! Evidence relative to the nature of such stains has been received in two or three cases, tried in the English Courts, where the question was raised on an allegation of criminal intercourse or of a consummated marriage. The witnesses, however, who have given evidence on these occasions, were washerwomen and chambermaids! The microscope in the above case undoubtedly furnished strong evidence against the prisoner, and as it was employed by experienced men, there could be no objection to its use. It may be observed in reference to this microscopical evidence, that M. Donné has discovered in the vaginal mucus of the human female, an infusory animalcule, which he calls the *Tricho-monas vaginæ*. The witness, therefore, who trusts to the use of the microscope on such occasions may be fairly asked, whether he is able to distinguish the spermatozoon from the tricho-monas. Those who are not used to microscopical investigations may be easily deceived, especially where the animalcules are dead and mutilated.

Sometimes the body of a female is found dead, and a medical witness is required to determine whether her person has or has not been violated before death. There is here some difficulty, because there may be no statement from the prosecutrix herself. The witness can seldom do more than express a conjectural opinion from the discovery of marks of violence on the person and about the genital organs. The presence of spermatozoa in the liquid of the vagina would merely prove that there had been intercourse, whether violent or not,—must depend on circumstantial evidence.

Capital punishment has been lately abolished in cases of rape. The statute law which refers to this crime, is the 9 Geo. IV. c. xxxi. s. 17, 18. According to the eighteenth section, "Carnal knowledge shall be deemed complete upon *proof of penetration* only." The words are, perhaps, not sufficiently precise; for by one judge, the law was thus interpreted—carnal knowledge, i. e., penetration is not complete, unless the hymen be ruptured. This, as it has been suggested, would divide penetration into vulval and vaginal, the former not constituting rape, but a common assault. Other judges, however, have not admitted a distinction of this kind. They have strictly adhered to the obvious and literal meaning of the words of the law, regarding the rupture of the hymen, not as a necessary proof, but as strong evidence of penetration. The question of penetration is not for the medical witness, but for the jury to decide from the whole of the facts. In one case of a young child, the prisoner was seen perpetrating the act, but it was proved that the hymen, which was normally placed, was not ruptured; yet this case was decided like that of *Rex* v. *Russen*, the crime was considered to be complete. Thus then, when the material evidence of penetration (rupture of the hymen) is wanting, proofs may be derived from other and non-medical sources.

Sodomy. Bestiality.—This crime is defined, the unnatural connection of a man with a man or with an animal. The evidence required

to establish it, is the same as in rape, and therefore penetration alone is sufficient to constitute it. There are, however, two exceptions : it is not necessary to prove the offence to have been committed against the consent of the person upon whom it was perpetrated ; and 2ndly, both agent and patient, if consenting, are equally guilty, but the guilty associate is a competent witness. In one case (*R.* v. *Wiseman*) a man was indicted for having committed this offence with a woman, and a majority of the judges held that this was within the statute. If it be committed on a boy under fourteen years, it is felony in the agent only ; and the same, it should seem, as to a girl under twelve. (Archbold 409.) The act must be in the part where it is usually committed in the victim or associate of the crime, and if done elsewhere it is not sodomy.

The facts are commonly sufficiently proved without medical evidence, except in the case of young persons, when marks of physical violence will in general be sufficiently apparent. Trials for this crime are very frequent, although it was not, like rape, specially excepted from capital punishment by the 4th and 5th Vict., cap. lvi. It is also said to be on the increase. (Law Times, January 4, 1845.)

ASPHYXIA.

DROWNING.

CHAPTER LII.

CAUSE OF DEATH. POST-MORTEM APPEARANCES. MARKS OF VIOLENCE.

THE CAUSE OF DEATH.—Many opinions have been entertained respecting the manner in which death takes place by drowning. It was at one time supposed that the water which passes into the stomach of a drowning animal, had an injurious effect and operated as the immediate cause of death. This opinion prevailed before the importance of the respiratory process in the economy was fully understood. It would, however, have been easy to show the insufficiency of this explanation by a simple appeal to facts. Water is not invariably found in the stomachs of the drowned; and again, it may be introduced into the stomach in much larger quantity than we are accustomed to meet with it in the body of a drowned person, without producing any deleterious effect. The presence of water in the bronchial ramifications of the lungs, has been also suggested as the probable cause of death;—it was thought that it operated here by arresting the circulation of blood in the minute pulmonary vessels. This explanation of the cause of death in drowning, would imply that water was always present in the lungs of the drowned, which, however, is not the case; and, indeed, when found, it is often met with in variable quantity,—facts which sufficiently show that this hypothesis cannot be entertained. Death has been also attributed to a collapse of the lungs, by which the blood is presumed to be mechanically prevented from traversing the pulmonary structure. It is a generally admitted fact, that a considerable quantity of air is, in most cases, expelled from the lungs during the act of drowning, but these organs are not commonly found collapsed in drowned animals,—and when this condition is observed, it is rather to be regarded as a consequence, than a cause, of death.

Some have ascribed death in drowning to a congested state of the cerebral vessels,—in other words, they conceive that death takes place in most cases by a species of apoplexy. That a congested state of the cerebral vessels, is often met with in the bodies of the drowned, is a fact which cannot be disputed; but the same degree of congestion is observed, not only in other cases of asphyxia, but also in the inspection of bodies where death has proceeded from various causes, unconnected with cerebral disturbance. There is no ground, therefore, for attributing death to an apoplectic attack;—a mere fulness of the cerebral vessels, is certainly of itself insufficient to justify this view, for upon the same evidence, we might pronounce three-fourths of those deaths which are distinctly referrible to other causes, to be dependent on apoplexy. The obstruction to the passage of the blood through the lungs, is sufficient to explain why we meet with a sanguineous congestion in the cerebral vessels of drowned subjects; and there is great reason to believe that the occurrence of this congestion, is posterior to the interruption of the cerebral functions. The most characteristic post-mortem appearance of apoplexy,—extravasion of blood, is rarely seen in the drowned, and probably where it exists, it might be traced to mechanical violence before submersion, or to the head coming in contact with hard bodies beneath the water. I have met with only two instances reported, where extravasation of blood on the brain was found:—the one was in the case of Leopold, Duke of Brunswick, who was drowned in the Oder, during the German war, (see Henke Gericht. Med, 327,) and the other was a case which occurred in London in 1839. In general the term apoplexy is applied to those cases of drowning, where there is great fulness of the cerebral vessels:—but there are also in most of these, signs of death from asphyxia. No doubt now exists among physiologists, that death by drowning is due to *asphyxia or suffocation*, in which condition the blood is either circulated in a state unfitted to support animal life, or its circulation through the minute vessels of the lungs, is wholly arrested. Asphyxia is induced in drowning, owing to a physical impediment to the introduction of air, and we have, therefore, in this form of death, a simple illustration of that state. The medium in which the individual is immersed, acts mechanically and as effectually, as a rope or ligature around the neck; for although air escapes from the lungs, and water penetrates into the bronchiæ, yet no air can enter, to supply the place of that which has already expended a certain quantity of its oxygen on the blood. Hence this fluid must circulate, if it circulate at all, in a state unfitted for the support of existence, and death will ensue.

When an individual falls into water, and is exposed to this kind of death, vain attempts are in the first instance made to respire. At each time the drowning person rises to the surface, a portion of air is received into the lungs, but owing to the mouth being on a level with the liquid, a quantity of water also enters and passes into the fauces. A large quantity of water thus usually passes into the mouth, which the

individual feels himself irresistibly compelled to swallow. The struggle for life may continue for a longer or shorter period, according lo the strength of the person, but the result is that the blood in the tungs becomes imperfectly aerated and exhaustion follows. The mouth then sinks altogether below the level of the water,—air can no longer enter into the lungs,—a portion of that which they contain is expelled and rises in bubbles to the surface,—an indescribable feeling of delirium supervenes, with a ringing sensation in the ears, the person loses all consciousness, and dies asphyxiated. Some persons who fall into water are observed to sink at once without making an attempt to extricate themselves. This may arise from the stunning produced by the fall, and if the fall take place from a great height, the effect is probably aided by the forcible compression which the thorax sustains, whereby the lungs become in great part emptied. Should the person be intoxicated, or otherwise incapacitated, as by striking his head in falling, he may not again rise. These different conditions under which death may take place, will sufficiently account for the great difference in the appearances met with in the bodies of those who have died under these circumstances Some medical jurists have considered that those who were submerged while living, frequently perished by *syncope,* and often by what has been termed syncopal asphyxia, a mixed condition. It has been supposed that the state of terror into which a person may be thrown prior to submersion, would be sufficient to bring on syncope, and this, it was presumed, offered an adequate explanation of the recovery of the apparently drowned, when the body had remained a long time in water. It may readily be admitted, that in some instances, the mental shock may be so great to a person falling into water, as to induce syncope: but it is impossible to determine how often this occurs, and its occurrence appears to be founded rather upon presumption, than upon actual observation.

It is obvious that those who die from apoplexy, concussion or syncope at or about the time they fall into water, cannot be said to die from drowning. An individual so situated, makes no effort to respire, and it is only by interfering with respiration, that the water operates. Admitting then that in strictness, asphyxia is the sole cause of death in drowning, the subject is of interest in medical jurisprudence, only because the apparent may be mistaken for the real cause. It may also be occasionally necessary to determine whether the person really died by drowning or not, i. e. whether he was asphyxiated by water or not:—since an answer to this question may materially affect the position of a prisoner charged with homicide. The conclusion at which we arrive is, that many persons may fall into water and appear to be drowned, whose deaths have actually preceded their submersion. They may have died from fright or terror at their situation, or have been killed by their heads coming accidentally in contact with hard bodies during the fall, or even with the surface of water itself; for this may be sometimes sufficiently resisting to produce concussion of the brain when

the fall is from a great height, and the head comes first in contact with the water. It is probable that some also perish owing to a shock received at the pit of the stomach by the violence of the fall. A shock thus received in the region of the heart, might possibly suspend the functions of that organ, and kill the person by inducing sudden syncope. A case is mentioned in the Dublin Medical Journal, for May 1837, which appears to bear out this view.

Drowning may operate indirectly as the cause of death. Thus it has been repeatedly remarked, that those who have been rescued from water in a living state, in spite of the application of the usual restoratives, have after some minutes or hours died: others have lingered for one or two days, and then have sunk apparently from exhaustion. In those who perish soon after removal from the water, death may be due to the exhaustion produced by the struggles of the individual for life, aided by the long contact of the body with a cold medium. When death takes place at a remote period, it may be due to disease, and the question will then be whether the disease was produced by the immersion in water, or not. Such cases occasionally present themselves before our Courts of law. One has been recently tried, (*Reg.* v *Pulham*, Gloucester Sum. Ass. 1845,) in which the prisoner was charged with the death of the deceased, by pushing him into a pond of water, from the effects of which he died. The deceased was an old man,—he was taken out of the water in a very exhausted condition, and died five weeks afterwards. One medical witness referred death to the effects of the immersion; but as he had not attended the deceased after the violence, and there was no clear account of the cause of death, the prisoner was acquitted. In most of these cases, it will be found exceedingly difficult to connect death with the immersion, when the fatal result does not take place until after so long a period. We must rely upon the nature of the disease, e. g. inflammation of some cavity, or organ, and its progress until death without intermediate recovery or interference by improper treatment, as the basis of our evidence. According to M. Devergie, (Méd. Lég. ii. 336,) of one hundred individuals who fall into the water or are exposed to the chances of drowning,—the following may be taken as the numerical ratio of the causes of death.

Asphyxia pure	25·0	Asphyxia	87·5
——— and Syncope	62·5		
——— and Cereb. Congestion			
Syncope, Apoplexy, or Concussion			12·5
			100·0

From this table we learn that out of one hundred bodies, removed dead from water, where death was due either directly or indirectly to immersion,—if the body be removed immediately after death, and examined soon after removal, the signs of drowning would

be present in about 25:—they would be imperfectly apparent (asphyxia more or less marked) in about 62, and they would be wholly absent in about 12. This table may not represent the actual truth, but as the medical jurists of Paris have ample opportunities of examining the drowned, it is probably as near an approximation, as the present state of science will permit us to reach. For a full examination of the causes of death in drowning by Dr. Loeffler, see Henke Zeitschrift der S. A. 1844. i. 1.

PERIOD AT WHICH DEATH TAKES PLACE.—A witness may be asked how long a time is required for death to take place by drowning. In giving an answer to this question, it must be remembered that all who fall into water and are exposed to the risk of drowning, do not really die by this kind of death. Thus all cases of death from syncope or apoplexy must be excluded from our consideration. Again some persons who are strong, who are good swimmers and retain their presence of mind,—may support themselves for a length of time in water, while others who are weak and delicate, may struggle only for a few seconds, and then sink exhausted and lifeless. There are two very different points involved in this inquiry: 1. How long can a person remain beneath the surface of water without becoming asphyxiated, (drowned?) and 2. After what period of entire submersion of the body, may we hope to resuscitate a person? In regard to the first point it may be remarked, that when the mouth is so covered that air cannot enter, asphyxia supervenes in the course of one or two minutes at the farthest, and the time at which this occurs, does not appear to vary materially with the individual. It has been observed that perfect insensibility has supervened after a minute's submersion, and it is probable that in most cases a few moments would suffice for the commencement of asphyxia. In the case of a diver who was accidentally submersed, at Spithead in July 1842, for *a minute and a half*, without the power of breathing, at the depth of eighty feet, it was observed that when drawn up he was faint, but sensible. (Med. Gaz. xxxi. 90.) Observations made upon sponge and pearl-divers, show us for how short a period a human being, even when practised in the art of diving, can continue without breathing. Dr. Lefevre, of Rochefort, found that among the Navarino sponge-divers, accustomed as they were to the practice of diving, there was not one who could sustain entire submersion of the body for two consecutive minutes. The average period of entire submersion, was seventy-six seconds. (Med. Gaz. xvi. 608.) According to Mr. Marshall, the best pearl-divers of Ceylon could rarely sustain a submersion of more than fifty seconds. Thus then it would appear from these and other observations, that asphyxia is probably induced in most individuals in the course of a few seconds, and that at the furthest it occurs in from a minute to a minute and a half.

The second point to be considered is—how long a period of entire submersion is required for death to take place, i. e. when is there no further hope of resuscitating a drowned subject? This question is of

great importance in relation to the treatment of the drowned. The insensibility which is the result of submersion, will give to a body which has been immersed only a few minutes or even seconds, the characters of apparent death; but we are not, therefore, to desist from applying every means in our power to restore animation. On the contrary, it is only a proper act of humanity that the means should be applied without delay, even to subjects which have remained so long in water, as to afford, physiologically speaking, but little hope of ultimate resuscitation. A man who would neglect the application of these, would consign the body to certain death, while, by adopting an opposite course, he might, perhaps unexpectedly to himself, succeed in restoring a fellow-creature to existence. Hence we are not to allow ourselves to be influenced, in the treatment of the drowned, by the shortness of the period at which death most commonly takes place: for it is possible that two individuals may be drowned under the same circumstances, and treated, on removal from water, in the same way; yet the means of resuscitation will be effectual in one case, while they will totally fail in the other. It ought to be borne in mind, that the susceptibility to the restoration of life, may be different in the two subjects: were this not the case, it would be impossible to explain why, under the most judicious treatment, every effort will fail in restoring animation in a subject which has been submerged only a few minutes, while the same means will perfectly succeed in resuscitating another subject which may have been submerged for more than twice the period.

Devergie states that it has been found impossible to restore some who had not been entirely submerged for more than *a minute*, and when the bodies were removed with all the warmth and pliancy of life about them: but on the other hand others have been recovered, who, there was reason to believe, had been *entirely* submerged for several minutes. It is necessary that these circumstances should be clearly explained; for many of the marvellous recoveries reported, have no doubt been cases of the resuscitation of individuals who had not been entirely submerged, i. e. with the head below water, for the period alleged. If we are called upon to state physiologically, how we can reconcile the accounts of resuscitation after the body has remained for a quarter of an hour, or even for a longer period, in water, with the fact of the general occurrence of death within the short interval of a few seconds or minutes from the time of submersion, we must look upon such accounts, provided their authenticity be placed beyond all doubt, as extraordinary exceptions to a very widely-extended rule. It is necessary to observe that the head of the subject may not have been under water during the whole of this time; the individual may have struggled long, and have risen frequently to the surface, or the upper part of his body may have received support from some mechanical obstacle. All these circumstances, as well as the depth of the water in which the body is found, should be duly considered before we proceed to admit statements, which are opposed to facts well esta-

blished by experiment and observation. In most of the cases on record, the evidence has been derived from ill-informed and ignorant persons, who were but little fitted to convey accurate information upon so important a question, and whose conjectures we should be extremely cautious in receiving. Besides the period of submersion has been stated upon conjecture, not upon actual observation of the time.

The following facts, it appears to me, may be relied on, in relation to this question. Mr. Woolley, a medical assistant of the Royal Humane Society, doubts, whether in the records of the society, there is a single well-authenticated instance of resuscitation after an entire submersion of five consecutive minutes. (Lanc. Jan. 1836.) Subsequently to this, however, he met with a case where the individual was recovered after five minutes' submersion. (Lanc. Oct. 1841.) In the Report of the R. H. Society for 1840, there were two cases of successful resuscitation after one minute and a half,—and two cases after three entire minutes' submersion. In a case communicated to me by Mr. Bloomfield, in 1841, a boy was recovered after a submersion of from five to ten minutes. In another, communicated to the Lancet by Mr. Smethurst, (July 1841,) a girl aged two years was recovered after ten minutes' immersion—it is not quite certain whether, in this instance, the head was under water during the whole of that time. A case of recovery after six minutes' alleged submersion will be found in the Med. Gaz. (xxix. 78). In the same journal (xxxi. 448) is perhaps one of the most remarkable of these cases, where an individual is stated to have been resuscitated after *fourteen minutes*' submersion; and the case carries with it great probability, although the time was derived rather as a matter of calculation from circumstances, than from actual observation. This is the longest authentic period with which I have been able to meet. Cases of alleged recovery, after half an hour and even three quarters of an hour, will be found reported;—some have endeavoured to explain these by assuming that the individuals in question, were restored from a form of syncope, which had occurred in consequence of the mental shock experienced at the moment of submersion. It has been admitted that syncope may occur under these circumstances, and it is possible also, that the susceptibility of resuscitation may remain longer in a subject labouring under syncope, than in one who has perished by asphyxia: but the question here obviously presents itself, whether the lungs can cease to act and the heart to circulate blood for the period of half an hour consistently with the maintenance of life. The medical jurist must remember, that neither of these functions can continue when the body remains entirely submerged: for it is impossible that air can enter into the lungs, and we know that the circulation, provided syncope be not previously induced, is not maintained above three or four minutes in a person so situated. There are few indeed who would be disposed to admit, that respiration and circulation could remain so long entirely suspended in any individual, whether he be in a state of syncope or asphyxia, without the complete destruction of life, or if they did admit

the possible occurrence of so great a deviation from the common phenomena of vitality, they would require better evidence for such an admission than that by which these cases are usually supported. In numerous experiments on drowned animals, I have never found that life could be restored, after the animal had remained entirely submerged for the space of four minutes. In one case where a stout healthy man had been submerged five minutes, and every means for resuscitation speedily used, the result was unfavourable. We are then bound unhesitatingly to declare, that in drowning, life is very speedily destroyed,—that the time within which resuscitation may be successfully attempted, is subject to variation,—and, lastly, that the cases which have been hitherto recorded of restoration after the lengthened submersion of half an hour and upwards, are to be regarded as extravagant fables.

Treatment.—A question has often arisen at coroners' inquests whether death may not have been really due to neglect in the treatment. The principles to be observed are, 1. To wipe the body dry. 2. To keep the head and shoulders raised. 3. To restore the warmth of the body. This may be done according to the means at hand, by warm blankets, bottles of hot water,—bags of hot sand,—the warm water bath or the warm air bath. (For an account of the latter see Med. Gaz. Sept. 1838.) The warmth should be especially applied to the feet and epigastrium. 4. The cautious application of stimulants, such as diluted ammonia, to the nostrils. 5. Having cleared the mouth and fauces, to move the chest in order to simulate the act of respiration. 6. The employment of stimulating embrocations such as the Lin. Camph. Comp. rubbed by a warm flannel on the trunk and the extremities. It is not advisable to employ venesection until signs of recovery appear, nor even then unless this treatment should be indicated by great cerebral congestion. Much difference of opinion exists on the propriety of introducing air into the lungs by artificial processes. Mr. Woolley, who has had considerable experience in these matters, denies its efficacy, (Med. Gaz. xvii. 663,) and states that in the cases in which he had been successful in resuscitating the drowned, he had not inflated the lungs. This is certainly strong evidence against the alleged necessity for the practice, and it is corroborated by the observation of Dr. Douglass, (Med. Gaz. xxxi. 449,) one of the most remarkable cases of resuscitation on record; for the individual here had been *fourteen minutes under water*, and no signs of returning animation were evinced until the treatment,—which consisted simply in the application of warmth and constant friction, had been persisted in for eight hours and a half from the time of the accident! Inflation of the lungs was tried, but not persisted in as it did not appear to be attended with any good effect and interfered with the rubbing, on which the greatest dependence was placed. Artificial inflation is, however, commonly used, and it is said successfully:—but other means, under which alone the apparently drowned have often recovered, have been simultaneously employed, so that it is rather difficult to say what share the inflation really had in the recovery. Certainly it should never be allowed to interfere with the application of those means by which *warmth* is restored to the skin. M. Marc states that more good is done by drawing air out of the lungs than by artificially inflating the organs. His experience was against the latter practice. Theoretically speaking, artificial inflation appears to be strongly indicated. Dr. Harvey considers it to be the best mode of treatment; (Med. Gaz. xxxvi. 897.); and Mr. Bloomfield informs me that he has found it to be a most effectual plan to introduce air by applying the mouth to the mouth of the deceased. Dr. Todd has recommended the use of electricity, but the obvious objection is that the means for this are not commonly at hand, and

whatever is done on these occasions, must be done quickly. The same objection holds to the employment of oxygen, as recommended by Dr. Wilson, but this gas might be kept ready for use, and with much better prospect of success. Dr. Wilson has suggested that it may be readily procured by heating a mixture of five parts of powdered chlorate of potash, with one part of powdered red oxide of iron. It has been long known that the chlorate mixed with one-eighth its weight of oxide of manganese readily evolves oxygen. These powders may be kept ready prepared in well-stoppered bottles. (Med. Gaz. xxxvi. p. 434.) Although the individual may have been only one minute submerged, if much time has elapsed before the means for resuscitation are employed, there can be no hope of success. It has been stated that after ten or fifteen minutes' submersion, there is but little hope of recovery, yet these attempts at restoring animation often fail from the delay which ensues in obtaining the means. Thus there will be a better chance of recovering one who has been five minutes submerged, where the treatment is immediate, than another who may have been only two minutes submerged, but where a delay of from ten to fifteen minutes has occurred in the application of the means. This obstacle to recovery is often overlooked,—attention being paid to the period of submersion only. On these occasions we should not be justified in declining to employ the means for resuscitation, merely because the body was cold and apparently lifeless. Another point to be considered is for how long a period should the efforts at restoration be continued. When the treatment is commenced under circumstances which justify a fair hope of success, it would be proper to continue the treatment for at least an hour. In Mr. Bloomfield's case, an hour and a half elapsed before there were any signs of returning animation. In Dr. Douglass's case resuscitation began to be only feebly established after eight hours and a half spent in the treatment! There is no doubt that this case would have been abandoned as hopeless by many, long before this period; especially as the man had been submerged fourteen minutes: and thus perhaps many persons are lost who might be recovered by perseverance. The tendency to restoration is often evinced by the occurrence of slight lividity in the face and convulsive twitchings of the facial muscles. So soon as resuscitation commences, it will be proper to abstract blood cautiously. In Paris, from 1821 to 1826, out of five hundred and seventy-six cases, four hundred and thirty were saved.

Post-mortem appearances.—In conducting the examination of the body of a drowned person, it is necessary to remember, that the external and internal appearances will vary much, according to the time which the body may have remained in water, or the period which may have elapsed, after its removal and before it is examined. Two subjects may be taken out of water at the same time—one may be examined immediately, while the examination of the other may be deferred for several days. In these cases, the post-mortem appearances will be no longer similar; and the difference will be particularly great when the last-mentioned body has been exposed to a high temperature and to the free access of air. Supposing that the body has remained in the water only a few hours after death, and the inspection has taken place immediately on its removal, the *skin* will be found cold and pallid, sometimes contracted under the form of cutis anserina. (Ed. Med. and Surg. Jour. Jan. 1837.) Livid discolorations of greater or less extent may be observed. The face is pale and calm, with a placid expression, the eyes half open, and the pupils dilated, the mouth closed or half open, the tongue swollen and congested, frequently pushed forwards to the internal edges of the lips, sometimes lacerated

by the teeth;—and the lips, together with the nostrils, covered by a mucous froth which oozes from them. If the body have been submerged for a longer period, or have remained long exposed before inspection, the skin will be found variously discoloured according to the degree to which putrefaction may have advanced. If three or four months have elapsed before its removal, the skin covering the legs may be, in the first instance, of a deep blue colour: but if the body be exposed to air, this colour gradually disappears, and the skin becomes brown. The influence of air upon the skin of a drowned subject, is most remarkable in the face and thorax. When the body has remained for some days in water and has been exposed for a few hours only after its removal, the temperature of the atmosphere being moderately high, the face will commonly be found livid and bloated, and the features so distorted, that they will be with difficulty recognizable. The change chiefly consists in the skin becoming at first of a livid brown colour, which gradually passes into a deep green. That these effects are to be ascribed to the free contact of air, appears evident from the fact, that they are most fully developed in those parts of the body, which are the most exposed to the atmosphere. Thus, the changes of colour in the skin are not commonly met with where any parts of the cutaneous surface have been in close contact, as in the axillæ and inner surfaces of the upper and lower extremities, where the former have been closely applied to the sides of the trunk, and the latter have remained in close proximity to each other. For the same reason, the discoloration is not commonly observed at the back of a subject, or in those parts where the body has been closely wrapped in clothes.

There is another external appearance which is sometimes met with in the drowned; the fingers occasionally present *abrasions;* and gravel, sand, or other substances may be found locked within the hands or nails of drowned subjects: for in the act of drowning, as common experience testifies, an individual will grasp at any object within his reach, and in his efforts to extricate himself, he may excoriate or wound his fingers. There are, however, many cases of drowning, in which this sign is absent. There may be no substance for the drowning person to grasp;—this will depend in a great degree upon the fact of the water being deep or shallow, of its being confined within a narrow channel or not, and many other contingencies. In all cases, when the individual is senseless before he falls into water, or when his death is occasioned by syncope from sudden terror, he will of course be incapable of making those exertions, which are necessary to the production of this appearance. The skin of the palms of the hands and soles of the feet is found thickened, white and sodden from imbibition, when the body has remained several days in water. On examining the body *internally,* we may expect to find in a recently drowned subject, that the viscera of the thorax will present the appearances indicative of asphyxia. The right cavities of the heart, and the vessels connected with them, are distended with blood,—the lungs are

sometimes found gorged, and at others pale and collapsed. If the subject has remained a long time in water before the inspection is made, the viscera of the thorax will not present the characters above described. Independently of the changes which may have taken place in consequence of putrefaction, the right cavities of the heart, and the vessels immediately connected with them, will be found collapsed and generally destitute of blood. Some physiologists have asserted that the *blood* remains fluid in the bodies of the drowned. Orfila observes, that with one exception, he has not met with blood in a coagulated state, in the examination of a drowned person. Probably much more importance has been attached to this appearance than it really merits. Some observers have found the blood coagulated in the drowned; and I have repeatedly seen coagula, like those usually met with after death, in the bodies of animals which were drowned for the sake of experiment. If the blood be generally found liquid, this may be due to putrefactive changes or to the imbibition of water. A greater or less fulness of the vessels of the *brain* is described as one of the appearances met with in a drowned subject. Some remarks have been already made on this point, and from these it is evident, that the state of the cerebral vessels, can afford no presumption that death has taken place by drowning. In regard to the cases which I have had an opportunity of examining, the quantity of blood contained within the cerebral vessels, has rarely been so great, as to call for particular notice. In examining the viscera of the abdomen, it will commonly be found that the *stomach* contains a certain quantity of water, which appears to enter into this organ by deglutition. The quantity is subject to great variation; sometimes it is large, at other times small, and in some instances no water whatever is to be met with. Orfila has remarked that the alimentary canal is occasionally much discoloured in drowned subjects. He observed, also, that when drowning took place while the process of digestion was going on, the mucous membrane of the stomach often had a red or violet tint. When the drowned subject had remained a long time in water, the lining membrane of the stomach was observed to acquire a very deep violet or brown colour. A knowledge of this fact, will be of importance in those cases, where the subject removed from water, is suspected to have been poisoned previously to submersion. Among the other appearances met with in the body of a recently drowned person which require to be mentioned, is the presence of a *mucous froth*, sometimes of a sanguineous hue, covering the lining membrane of the trachea, which may be itself slightly reddened. Water is also occasionally found in the ramifications of the bronchiæ, but in very variable quantity. If the body has remained a long time in water, or if, after removal, it has been exposed to the air several days previously to the inspection being made, there is commonly no appearance of mucous froth in the trachea or its ramifications.

WAS DEATH CAUSED BY DROWNING?—It is obvious that for a correct

solution of this question, we shall have to consider the appearances met with in the bodies of the drowned, and to determine how far they are characteristic of this form of death. Among the *external* signs of drowning, when the body is seen soon after death, are paleness of the surface and the presence of a mucous froth about the nostrils and lips. The absence of these appearances, however, would not prove that the individual had not been drowned: for if the body has remained some time in water, or if it has been long exposed to air before it is seen by a medical practitioner, the cutaneous surface may have undergone various changes of colour, and mucous froth may no longer be found adhering to the nostrils and lips. In speaking of the *external* appearances of the body, it was stated that foreign substances are sometimes locked within the hands or lodged under the nails of drowned subjects. This fact may occasionally afford strong circumstantial evidence of the manner in which the individual has died. If materials be grasped within the hands of the deceased, which have evidently been torn from the banks of a canal or river, or from the bottom of the water in which the body is found, we have strong presumptive evidence that the individual died within the water. For although it is possible to imagine that the deceased may have struggled on the bank and have been killed prior to submersion, yet in the value attached to this sign, we are presuming that there are no marks of violence on the person, nor any other appearances about the body, sufficiently striking to lead the examiner to suspect that death has taken place in any other way than by drowning. If the substance, locked within the fingers or finger-nails, be sand of the same character as that existing at the bottom of the river or pond, it is difficult to conceive any stronger evidence to establish the fact of death having taken place subsequently to submersion. The abrasion of the fingers is a circumstance of minor importance,—no value could be attached to this state of the fingers as an indication of the individual having perished by drowning, unless it were in conjunction with the appearances above described. A witness would be constrained to admit in many cases, that the extremities of the fingers might become abraded or excoriated after death, or even before submersion, while in no case could he be called upon to make, in regard to substances found grasped within the hands, an admission, which would invalidate the evidence deducible from this condition. This must be regarded as a most satisfactory proof of the individual having been alive after his body was in the water. It is well known that when two or three persons are drowned by the same accident, they are not unfrequently found clasped within each other's arms,—a fact which at once proves that they must have been living when submerged. So if a dead body be discovered still holding to a rope, cable, or oar, no further evidence is required to show that the deceased must have died by drowning. The signs upon which medical jurists chiefly rely as proofs of death from drowning are, 1. water in the stomach; and, 2. water with a mucous froth in the trachea and lungs.

Water in the stomach.—It has been stated, that water commonly passes into the stomach of a living animal while drowning, and this most probably takes place by the act of deglutition: for it has been observed, that when the animal is stunned prior to submersion, water does not pass into the œsophagus. As a proof that its entrance into that organ depends on deglutition, it may be stated that the quantity contained within the stomach is greater when the animal is allowed to come frequently to the surface and respire, than when it is maintained altogether below the surface. The power of deglutition is immediately suspended on the occurrence of asphyxia, and in this way, may we perhaps most satisfactorily account for the difference observed in the two cases. The water thus found is in variable quantity; there are some cases of drowning in which water is not discovered in the organ. It was found by Dr. Ogston, of Dundee, in five cases out of seven. (Ed. Med. and Surg. Jour. January 1837.) In dissecting cats which had been drowned, I have repeatedly remarked, the absence of water from the stomach; in these instances, the animals had been invariably kept under water from the first moment of their submersion, and thus in a condition but little favourable to the exercise of deglutition. Water does not readily penetrate into the stomach of a subject which has been thrown in after death; the parietes of the œsophagus applying themselves too closely to each other, to allow of the passage of the fluid. If putrefaction has advanced to any extent, it is possible that water may enter; but the practitioner will easily judge from the general state of the body, how far this process may have been concerned in the admission of fluid into the stomach and alimentary canal. It has been suggested that water may be found in the stomach of a subject apparently drowned, in consequence of that liquid having been drunk by the individual or artificially injected by another into the stomach after death. It is difficult to conceive under what circumstances such an injection could be made, or what purpose it would answer. The quantity would determine whether it was likely to have been drunk by the person before immersion. It is of course presumed, that the liquid contained within this organ, is of the same nature as that in which the body is immersed; for it is possible that fresh water may be found in the stomach of a person drowned in salt water, and in such a case it would be obviously improper for a medical witness to affirm from the mere existence of water internally, that the individual had died within the medium in which his body was discovered. If the water contain mud, straw, duckweed, moss, or any substance existing in the pond or river where the drowning occurred, this is a proof of its having been swallowed by a living person, when the inspection is recent. The absence of water from the stomach cannot, however, lead to the inference that the person has not died by drowning, because in some instances it is not swallowed, and in others it may drain away and be lost after death. The following case occurred at Maidstone, in July 1843. The body of a young woman was found in the Medway, under circumstances that led to a suspicion of murder. The medical witness

deposed that there were no marks of external violence nor any sign of the deceased having struggled with the supposed murderers. There was some long grass at the back of the mouth, and in the fauces. The grass was not the same as that growing on the banks of the river, but such as grew at the bottom, and which the deceased had probably swallowed after having gone living into the water. On this evidence the accused was discharged.

Mucous froth in the trachea and lungs.—The trachea in a drowned subject is frequently covered by a mucous froth, and this is stated, in some instances, to have been so abundant, as to have filled the bronchi and their ramifications. It is sometimes disposed in a layer of minute vesicles tinged with blood. The origin of this appearance has been variously accounted for; but it is probable that it is produced by the simple agitation or admixture of the air respired in the act of drowning with the mucous secretion of the air passages, which, perhaps under these circumstances, is more copiously poured out. This mucous froth is not always met with in drowned subjects: 1. It has not been found in those who have sunk at once below the surface. 2. The appearance may not be seen when the subject has remained for a long period in the water after death, since by the free passage of this fluid into and out of the trachea, the mucous froth, although formed in the first instance, will disappear. 3. If, after removal from the water, the subject be exposed to the air for several days before it is examined, it is rare that this appearance is seen. 4. The mucous froth may have been formed in the trachea, but it may have entirely disappeared, owing to the incautious manner in which the body has been handled on its removal from the water. Thus, if the subject be removed from water with the head depending, any fluid which may be contained within the lungs will escape; and in passing through the trachea, this fluid will effectually obliterate the frothy appearance. A similar appearance has been found in those who have been hanged, or who have died from apoplexy. The introduction of any liquid into the trachea during deglutition, may produce it. A case is reported where, in poisoning by laudanum, water containing sulphuric ether was forced down the throat of a person after the power of swallowing had ceased. On dissection, a quantity of reddish froth was found filling up part of the trachea.

Water in the lungs.—Many contradictory statements have appeared relative to the presence of water in the lungs of the drowned; but it is not unfrequently met with; for the glottis does not in every case of drowning become so effectually closed, as to prevent the introduction of a portion of liquid into the pulmonary cells. In some instances there is none; and when present, the quantity which is found in the bronchiæ after death, depends on many contingencies. It is commonly small, often about an ounce, but it is subject to variation, and is probably affected by the number of forced attempts at respiration made

by the drowning animal. In experiments on animals, I have not remarked any difference in the quantity whether the animal was allowed to rise to the surface and respire, or whether it was maintained altogether below. There is but little doubt that the quantity becomes increased after death, because it is now well known that water will penetrate into the lungs, before the access of putrefaction, when a body has been thrown in dead. This it is important for a medical jurist to bear in mind, as it may influence materially the opinion which he may be disposed to form on the discovery of water in the lungs of an apparently drowned subject. Water may therefore be present in the lungs, and yet it will afford no evidence of drowning. It has been suggested that water may have been injected into the lungs after death, in which case, an incorrect opinion may be formed from its presence, if the body were discovered on the bank of a river or canal. This, however, is an obstacle but little likely to interfere with any medical investigation. On the other hand, the absence of water from the lungs of a subject found apparently drowned, must not be considered to indicate that death was not a consequence of drowning; for if the body of a drowned person be allowed to remain with the head depending, the water originally contained within the lungs, will drain out; or if it be long exposed before undergoing an examination, the probability is, that none will be discovered in these organs, since in the progress of time it may disappear by imbibition and evaporation.

Buoyancy of the body.—It is to be remarked that the human body whether living or dead, will equally sink,—its specific gravity being somewhat greater than that of water. If a dead body be found floating or on the surface of water, it must either be suspended by some mechanical cause, or by the air generated from putrefaction. A strange error formerly existed on this point: it was thought that those who died in water (by drowning) sank, while the bodies of those who were thrown in dead, floated. (See the trial of *Spencer Cowper*, Hertford Assizes, 1699.) It was here brought forward as a proof of murder by strangulation, that the body of the deceased, a female, was found floating in a pond, and hence it was contended that she must have been dead before her body was put into the pond! The bodies of the drowned, when they float from putrefaction, generally rise to the surface about the fourth or fifth day after submersion, unless held down by mechanical obstacles. Male subjects are said commonly to float with the back on the surface, while female subjects float with the abdomen on the surface of water.

The body of a drowned person when it has been long in water, sometimes undergoes certain peculiar changes, by which a fatty compound, adipocere, is produced. The experiments of Chevreul have proved that this compound is an animal soap, with a base of ammonia or lime, the former alkali being the result of the decomposition of the nitrogenized principles of the body, while the fat is acidified. A medico-legal question has more than once arisen respecting the length

of time which a body should remain in water, in order that this adipocerous transformation of the tissues may be observed. Dr. Gibbs of Bath, found that by macerating muscle in water for about a month, he was only able to procure a small quantity of adipocere. Dr. Harlan, of Philadelphia, observed that the integuments of a cranium were, by maceration, converted into adipocere in about six weeks. In some experiments which I have made on the subject, the conversion of muscle and fat to adipocere was not complete in stagnant water, under a period of two months. Thus, then, we may say, that a month is about the earliest period at which the change is likely to be observed. The experiments of Orfila and Devergie, prove, that with bodies interred in the soil, the change is much longer in taking place. The following singular case will show the medico-legal relations of this subject. It was tried at the Warwick Lent Assizes, in 1805.

A gentleman who was insolvent, left his home on the 3rd November, and on the 12th December following, his body was found floating in a river much decomposed, and the dress rotten. There was no doubt that he had committed suicide. A few days after he was missed, a commission of bankruptcy had been issued against him; and the question was, whether or not he was living at the time it was issued. If not living, then the commission was void. As nothing positive was known on the subject, the only evidence on the point, was derived from the examination of the body. The muscles of the lower part of the abdomen and the glutei were found to have become converted into adipocere; and from this fact, it was inferred to be in the highest degree probable, that his body had heen in the water during the whole period of his absence—thirty-nine days; in short, that he had drowned himself on the day he left the house. Several medical witnesses were summoned on both sides. Dr. Gibbs and two others gave a strong opinion, that from the slow formation of adipocere in the drowned, it was reasonable to infer, that the body of the deceased had been in the water for the whole period of five weeks and four days. The jury returned a verdict in accordance with this view, namely, that the deceased was not living at the time the commission was issued against him. Mr. Callaway has informed me, that he was required to give evidence in a similar case in the year 1836.

We have now reviewed the whole of the evidence, which the post-mortem examination of a drowned subject, is capable of affording to a medical witness. It will be seen that the only characters met with internally, upon which any confidence can be placed to indicate that the individual has been drowned, are the presence of water in the stomach, and the presence of a mucous froth on the lining membrane of the trachea; but at the same time, the restrictions to the admission of these signs as positive evidence of drowning, may be such as to throw great uncertainty on the correctness of a medico-legal opinion, founded simply on their existence. The practitioner must then determine, before he decides positively in a question of this nature,—whether there be any appearance about the person which would lead to the suspicion that death had been caused in another way. When he has provided himself with this negative evidence, and he finds that the characters already enumerated, are present;—or if absent, he can, with any show of probability, account for their absence,—he is then justified in giving a decided opinion on the subject.

In consequence of the uncertainty attendant on the appearances of drowning, barristers have considerable advantage in cross-examining those medical witnesses who appear for the prosecution. Legal ingenuity is here often carried to the utmost, to show that there is no positive or well-defined *sign* of drowning; and therefore to draw the inference that the deceased must have died from some other cause. A trial took place at the Central Criminal Court, April 1841, in which the witnesses were very severely examined on the appearances caused by drowning. (The *Queen* v. *Longley*.) The general impression among non-medical persons appears to be, that whether in drowning or suffocation, there ought to be some particular visible change to indicate at once the kind of death; but it need hardly be said that this notion is founded on very false views; and if the reception of medical evidence as to the cause of death, be made to depend on the production of some such positive and visible change, —then it would be better at once not to place the parties charged with the offence upon their trial, because the crime could never be proved against them. A medical inference of drowning is founded upon a certain series of facts, to each of which individually it might be easy to oppose plausible objections; but taken together, they often furnish evidence as strong as is commonly required for proof of any other kind of death. In the case above referred to, the prisoner was cleverly defended. The deceased, a child, was drowned by the mother. When the body was removed from water, the mouth was closed: the prisoner's counsel wanted to make it appear, that it was most usual to find the mouth *open* in cases of drowning; and then went on to say, "that the only proof of suffocation by drowning which had been adduced by the medical witness, was the frothy mucus found in the air-cells, —that it could not have got through the mouth was quite certain, because the mouth was proved to have been closed. The air might have passed into the air-cells of the child, whilst struggling in its mother's arms, just as well as whilst struggling in water!" After what has been stated, it is not necessary to point out the fallacy of the assumptions involved in this argument; but it is much to be regretted, that medical evidence should be allowed to be presented to a jury in such a perverted form. The wonder is, that even in a case of undoubted criminality (as in this particular instance) a conviction should ever occur. See also the case of the *Queen* v. *Owen, Thomas and Ellis*. Stafford Lent Assizes, 1840.

Marks of violence on the drowned.—The chief inquiry with regard to marks of violence on the drowned is, whether they resulted from accident or design, and in forming an opinion a witness must give due value to the accidents to which a body, floating loosely in water, may be exposed. Ecchymoses of considerable size, are sometimes seen on drowned subjects, where they have been carried by a current against mechanical obstacles in a river or canal. If the deceased fell from a considerable height into water, his body, in falling, may have struck against a rock or projection, and have produced a very extensive mark of violence. It is manifestly impossible to lay down any specific rules for forming a decision in these cases, since probably no two instances will be met with which will be perfectly similar. In clearing up these doubtful points, everything must depend on the tact and acumen of the practitioner who is called upon to conduct the investigation. The first point which he has to determine is, whether the injuries on the body were produced before or after death. (See antè, Wounds, p. 287.) If after death, then they ought to be obviously of accidental origin. Accidental violence may sometimes be of a very serious nature,—so serious that a practitioner might well doubt, whether it did not indicate that the deceased had been violently injured prior to

submersion. If a dead body were taken out of water, with one or both extremities dislocated, or the cervical vertebræ fractured; and a surgeon were asked whether such an injury could be accidental and coincident with or consequent on drowning, the answer would probably be in the negative. But a case has occurred where both arms have become accidentally dislocated at the shoulders in the act of drowning; I allude to that of a man, who, some years since, jumped from the parapet of London Bridge into the Thames. This exploit, it appears, the man had previously performed with impunity, but in this instance, he sank and was drowned. Both his arms were found dislocated, in consequence, it is presumed, of his having fallen with them in the horizontal position, instead of placing them closely to his sides. The concussion on falling into the water, had sufficed to produce the accident. (Smith's For. Med. p. 228.) Here then we have a proof that even the mechanical resistance offered by water alone, may give rise to marks of very violent injury on the person. (See post, p. 581.) Extravasation of blood may take place in the cavities from this cause. Dr. N. Chevers informs me that he assisted in examining the body of a sailor who fell into the water vertex downwards; and it was found that there was an extravasation of blood in the head, beneath the arachnoid. It has been observed, with respect to superficial marks of violence, that bruises or contusions are not always visible on the bodies of the drowned, when they are first removed from water. This may be owing to the skin having abundantly imbibed water, and concealed the colour of the ecchymosis. After a short exposure to air, the water evaporates, and the bruise or contusion becomes visible. The great point with regard to all marks of violence on the drowned, is to throw light upon the questions: 1, whether drowning was really the cause of death; and 2, whether, if so, the act was the result of accident, suicide or homicide. This last question does not concern a medical witness so much as the jury, who will determine it from the facts proved before them.

It has been already stated, that dislocations may result from accident in the act of drowning; and we must be also prepared to admit, that wounds of a most severe description, such as stabs or gun-shot wounds bearing a mortal character, may be found on the body without justifying an imputation of murder. Suicides have frequently produced on themselves such personal injuries before plunging into the water. So poison may be found in the stomach, and yet all the facts be compatible with suicide. In June 1838, a female swallowed an ounce and a-half of arsenic, and afterwards threw herself into the river Mersey, from the deck of a vessel. She was picked up and resuscitated, but died in a few hours afterwards from the effects of the poison.

Again, it should be remembered, that the hands and feet may be voluntarily bound by a suicide, and a heavy weight attached to his body, in order to enable him the more effectually to accomplish his purpose. All these are conditions which must be so generally known to be com-

patible with suicide, as scarcely to require the necessity for advising caution. Many instances are reported which show that suicides occasionally resort to the most singular expedients, in order to deprive themselves of the power of struggling against this kind of death. (See Ann. D'Hyg. 1833, i. 207.) There is, however, one case of rare occurrence, in which a practitioner would be apt to be misled by trusting to the appearances found on the drowned. If a dead body were removed from water with a deep ecchymosed circle round the neck, evidently produced by a cord or ligature, but no traces of which could be found, it is not improbable that a suspicion would be at once raised, that the deceased had been murdered by strangulation, and the body afterwards thrown into water.

An accident occurred a few years since, in which a gentleman and his wife were thrown into the water by the overturning of a small boat. The lady was drowned. On an examination of the body, subsequently made, a livid circle was found round her neck, as if she had been strangled. She had evidently died by drowning, but the mark had been produced by the string of a cloak, which she wore at the time of the accident. In her struggles to reach the boat, it is presumed that the tide had drifted the cloak in the opposite direction, and thus produced the appearance of strangulation. It is not improbable that this accelerated death. Barzellotti mentions the case of a man who was drowned in the Po, while being escorted along the banks of the river, as a prisoner, by a party of soldiers. The man attempted to escape, and was drowned. Besides the ordinary marks of drowning, there was a deep livid circle, extending completely round the neck, and immediately below this, another mark but paler in colour. The skin over the trachea was ecchymosed. It was supposed that the deceased had been strangled by the soldiers, and his body thrown into the water, but from the appearance of the marks and other circumstances, Barzellotti gave it as his opinion, that they were produced by the collar of a coarse linen shirt which had been tightly buttoned around the man's neck,—the collar had retracted from the imbibition of water, and had thus produced the appearance of strangulation like any other ligature. (Questioni di Medicina Legale. i. 329.) For another case, see Henke's Zeitschrift, 1840, i. 126. Erg. H.) The following case was mentioned to me as having occurred during the heavy floods in the winter of 1839. A man was carried away and drowned in attempting to ford a swollen stream. When the body was found, it had been so placed by the current, that the fore-part of the neck was locked against the stump of a tree, giving rise to an ecchymosed patch like that which is commonly produced by manual strangulation. For an interesting case, in which there was much violence to the neck, see Henke Zeitschrift, 1842, i. 256, Erg. H.

It might be said, that in cases of this description, circumstantial evidence would commonly show how the mark had originated. In admitting the truth of this observation, we must remember that circumstances, as matters of proof, do not always present themselves to our notice or occur to our judgment, at the precise time that the course of justice stands most in need of them. While then we use great caution in drawing an inference where there are such strong grounds for suspicion, we should not neglect to examine carefully the most trivial appearances. In one remarkable case of murder, where the body of the deceased was discovered in a mill-stream, there was only one slight ecchymosed depression in the fore-part of the neck, as if from a finger. The surgeon suspected from this, that the deceased

had been strangled. The marks of drowning in the body were wanting. This suspicion was afterwards confirmed by the detection of the criminal.

Fractures are not often met with in the drowned as the result of accident during or after the act of submersion. Certain fractures likely to be followed by immediate death, may forbid the supposition of their having occurred after the act of submersion, and a careful examination of the body may show that they were not likely to have arisen from accident at or about the time of submersion. This point was raised in the case of *Reg.* v. *Kettleband*, (Nottingham Winter Ass. 1843,) where the prisoner was charged with the murder of his son, a boy aged ten years. The deceased was found dead in a pond soon after he had been seen healthy and well. An inquest was held, and as usual no inspection of the body was required by the coroner, and the jury were directed to return a verdict of "found drowned." An inspection was, however, subsequently made. The neck was observed to be very loose, and on further examination the processus dentatus was found to be separated from the atlas and the ligaments were ruptured! The three medical witnesses who gave evidence at the trial, deposed that this displacement had caused death by compressing the spinal marrow,—that the injury had occurred during life,—that it was not likely to have been caused by accident from a fall into the water, as there was no mark of a bruise about the head, and the pond was proved to be small, with a soft muddy bottom. All agreed that such an injury was not likely to have arisen from a blow or a fall under any circumstances, because it required for its production, that the body should be fixed and the head forcibly rotated on the trunk. It was in itself sufficient to account for immediate death, and it could not occur by accident after death from any other cause. Hence it was inferred, 1. that death could not have been caused by drowning; 2. that it had resulted from the compression of the spinal marrow, by displacement of the second vertebra; and, 3dly, that this injury must have been intentionally produced by some person. Circumstances fixed the crime on the prisoner, and the jury returned a verdict of manslaughter; although the nature of the injury, admitting that it was not the result of accident, proved that the prisoner must have acted with a most cool and deliberate intention to destroy life! This case furnishes a serious commentary on the practice of certain coroners in denying the necessity for an inspection, and in directing what is called an open verdict of "*found drowned*," where a body is taken out of water! It is an important medico-legal question, whether fractures of the *cervical vertebræ* can occur from accident alone, about the time of drowning. In the above case, the medical witnesses had probably good reasons for denying that the injury was accidental, although such an opinion cannot be always expressed merely from the absence of marks of violence on the head. Mr. South quotes the case of a man who threw himself into a river to bathe from a height of seven or eight feet, the water being only three feet deep. He rose to the surface, but fell back senseless. When he recovered his consciousness, the account he gave of the accident was, that he felt his hands touch the bottom of the river, but to save his head drew it violently back, upon which he lost all consciousness. He died in about ten hours, and on examination the back of the neck was much ecchymosed—the interspaces of the muscles were gorged with blood, and the vertebral canal filled with it. The body of the fifth cervical vertebra was broken across above the middle of its depth, and the two pieces were completely separated from the lateral parts. As there was no mark of contusion or dirt on the head, Reveillon, who reports the case, believes that the fracture arose from muscular action, and not from a blow received by striking the bottom; but this is doubtful. In another instance related by Mr. South, a sailor jumped headlong into the sea to bathe, a sail being spread three feet below the surface. He immediately became motionless, and died in forty-eight hours. The fourth and fifth cervical vertebræ were found extensively fractured, and the spinal marrow crushed and lacerated. (Chelius's Surgery, Part vi., Fractures.) In this case, the frac-

ture must have resulted from contact with the water or the sail; but as the latter was freely floating, this would be a yielding medium, hence this serious injury may occur accidentally in cases in which we might not be prepared to look for it. (For an important medico-legal case, involving many questions connected with marks of violence on the drowned, see Ann. D'Hyg. 1839, ii. 195.)

WAS THE DROWNING THE RESULT OF HOMICIDE, SUICIDE, OR ACCIDENT?—Although the question whether the act of drowning was the result of suicide or murder properly falls within the province of a jury, there are certain points in relation to it which here require to be noticed by a medical witness. In the first place, drowning may take place without the immersion of the *entire body* in water.

An interesting case of this kind, which was the subject of a criminal trial, was referred to me by Mr. Aldred, of Norwich, in March 1841. The case was tried at the Norwich Lent Assizes of that year, (The *Queen* v. *Yaxley*,) and the prisoner was convicted. It appeared that the mode in which the prisoner destroyed her infant child, was by immersing its head for a few minutes in a pail of water. She removed it before it was quite dead, but it soon died with slight convulsive motions of the limbs. The case was rendered obscure by the fact that the whole of the body had evidently not been immersed, and the only conceivable means of drowning were in a small duckpond adjoining the house, which was covered with weed, but no weed was found in the stomach, although a quantity of water was there present. A case occurred in London, in 1841, where a drunken man was drowned by falling on the bank of the Surrey Canal, with his head partly in the water, while the greater part of his body lay on the bank out of the water. It was by partial immersion that the Italian boy, Carlo Ferrari, was destroyed some years since by *Bishop* and *Williams*, who afterwards attempted to sell the body for the purposes of dissection. The murderers first intoxicated the deceased, and then suspended him by the heels in a well, so that his mouth was but a few inches below the level of the water.

A medical man therefore must not allow himself to be deceived respecting the cause of death, on finding that the *whole* of the body has not been immersed. In this form of murder, when the inspection is recent,—water with or without weeds or other foreign matters will be found in the ear-passages. (See ante p. 480.)

It has been a debated question, whether a person intent on suicide could have the power to drown himself in shallow water. The occurrence of numerous cases has long since established, that suicide may be perpetrated under these circumstances, as also that death may be due to accident. Thus a man in a state of intoxication may die from drowning, by falling with his face in a shallow stream or pool of water. In short, a depth of water of only a few inches would suffice to cause all the phenomena of death by drowning; but from an external view of the body, the cause of death might not even be suspected.

HANGING.

CHAPTER LIII.

CAUSE OF DEATH. POST-MORTEM APPEARANCES. MEDICO-LEGAL QUESTIONS.

Cause of death.—By hanging, we are to understand that kind of death in which the body is wholly or partially suspended by the neck, and the constricting force is the weight of the body itself; while, in strangulation, the constricting force is due to some other cause. In both cases death commonly results from asphyxia, although this must depend in a great measure upon the position of the ligature on the neck. If this be loose, or applied to the upper part of the neck, a small quantity of air may still reach the lungs; and then the cerebral circulation becomes interrupted by the compression of the great vessels of the neck. In this case, apoplexy of the congestive kind is induced, and operates as the immediate cause of death. It is easy to conceive that there may be a mixed condition of asphyxia and apoplexy, and according to the observations of Professors Casper and Remer, this is actually met with in the greater number of instances. The following tables represent the results at which they have arrived from the examination of a large number of cases.

	Remer.	Casper.
Apoplexy	9	9
Asphyxia	6	14
Mixed conditions	68	62
Total	83	85

It has been frequently observed in the execution of criminals, that death does not constantly ensue within the same period of time; and we may probably best explain this fact by a reference to the greater or less degree of constriction produced by the ligature. If the rope should press upon the larynx or above that organ, the occlusion of the air-passages will not be so complete, as if it pressed upon the trachea immediately below the cricoid cartilage. A slight degree of respiration might, in the former case, continue for a short interval, by which the life of the person would be prolonged; while in the latter, death would

be immediate. If the trachea be in part ossified, the pressure of the cord is less perfect, and death will then take place more slowly. It has been supposed that the immediate cause of the stoppage of respiration, was a pressure produced by the cord on the nerves of the neck; but we must consider it as very improbable that, under the circumstances in which hanging generally takes place, the cord should exert any pressure on the nerves sufficient to produce death. In the greater number of cases of suicidal hanging, which are commonly unattended with much violence, the pressure on these nerves cannot obviously exist; and in violent hanging, the projection of the anterior parts of the neck must suffice to prevent these slender nervous filaments from becoming exposed to such a degree of compression, as directly to impede the exercise of their functions.

There is an occasional cause of death in hanging, which appears to have been first brought to the notice of the profession by Louis. Having remarked that, in public executions, death sometimes took place with great rapidity, and in other cases more slowly, he was led to inquire into the circumstances. He found that in the cases of rapid death, the executioner was in the habit of giving a violent rotatory motion to the body of the criminal at the moment it was turned off, whereby a displacement of the dentiform process of the second cervical vertebra took place, so that the spinal marrow became suddenly compressed. This cause of death must be extremely rare :—as a general rule it is only likely to be observed in very corpulent subjects where a long fall is given to the cord, and where much violence has been at the same time employed by the executioner. It is seldom met with in subjects criminally executed; and in cases of suicidal hanging it is so rare, that Devergie found the ligaments between the first and second cervical vertebræ ruptured only once in fifty-two cases. M. de la Fosse considers, from the observations which he has made on the subject, that, in violent hanging, the dentiform process of the second cervical vertebra, is much more likely to be fractured than to become displaced, and he found this in the case of an executed criminal. On an examination of the body of this subject, he discovered that the two first cervical vertebræ had been completely separated from the remainder of the spinal column by the rupture of the intervertebral substance, and that they were firmly attached by their ligaments to the occipital bone. The dentiform process and body of the second vertebra, were detached from the bony ring, and were connected as usual with the anterior arch of the atlas. The spinal marrow had become compressed by the fractured portions of the vertebræ. Probably further observations would show that the injury to the spine is not always of the same nature, and that fractures of the vertebræ are really more frequent than simple luxations of the odontoid process; but, in the mean time, we must admit that such injuries may occur in hanging, and that when they do occur, death must be very sudden. But death may proceed from mere effusion of blood on the spinal sheath, thereby giving rise to fatal compression. This is likely to happen when tho head

falls or is bent suddenly backwards, so that the weight of the body is supported on the back of the neck. See an interesting case of this kind by Mr. Campbell de Morgan, post.

Death appears to take place very rapidly in hanging, and without causing much suffering to the individual. When the suspension of the body has only continued a few minutes, it has often been found impossible to restore life; and indeed the period at which resuscitation may take place, will vary in different subjects according to circumstances. Supposing the hanging to be unattended with violence to parts about the neck, it is possible that some individuals might be resuscitated after five minutes suspension or longer. Others again may not be recovered, when they are cut down immediately after suspension,—a fact which depends probably on the different degrees to which asphyxia or apoplexy has extended.

Treatment.—Venesection, cold affusion, with the vapour of ammonia and other stimuli, may be employed on these ocasions. The introduction of oxygen into the lungs or the application of electricity in the course of the spine might be also attended with benefit. Much will depend, as in drowning, upon the time at which assistance is rendered after the body has been cut down. The following case of recovery, in which however asphyxia was not complete, was reported in the Lancet, Nov. 1839. A robust woman, aged thirty-three, hung herself while slightly intoxicated. She was missed about ten minutes before she was found suspended to a bedstead, but how long she had been thus hanging, it was impossible to determine. Medical assistance was rendered to her in about ten minutes after she had been cut down. She was then quite insensible,—her respiration slow and laborious, and her pulse barely perceptible. The countenance was pale,—there was no lividity—the lower jaw was depressed, the extremities were moderately warm, and the hands convulsively clenched,—the pupils were somewhat dilated, and barely susceptible of the stimulus of light. A dusky red mark of a quarter of an inch in breadth, was distinctly observed encircling the upper part of the neck, forming an angle over the ramus of the jaw on the right side, where the knot of the ligature (a silk handkerchief) had rested, and in consequence of this, the constriction was incomplete. The patient was twice copiously bled, mustard sinapisms were applied to the calves of the legs, hot water to the feet, and cold applications to the head. After thirty-two ounces of blood had been abstracted in half an hour, the breathing became stertorous, the pupils fully dilated, the lower jaw fell further, the sphincters became relaxed, and the patient appeared to be rapidly sinking. Ammoniacal liniment was rubbed on the chest, and the woman so far recovered in an hour, as to be able to swallow: but although she was conscious of pain, she remained comatose until the evening, when she became perfectly sensible of surrounding objects. This was evidently a case of imperfect suspension where, from respiration still continuing, there was every hope of recovery. The cerebral circulation had here become disordered. Persons may die indirectly from the effects of hanging. A man aged sixty, hung himself, was cut down and resuscitated. The breathing was stertorous, and he died in two days afterwards.

An interesting case of this description was communicated to the Lancet (January 6, 1844) by Dr. Shearman. A powerful athletic man, who had been committed to prison for theft, hung himself. He was found apparently dead, hanging by his own handkerchief. He was cut down, and seen by Dr. S. half an hour after the occurrence. The man was then apparently lifeless,—he neither breathed nor moved, nor had any perceptible circulation. The face and neck were much swollen and livid, and the ecchymosed mark of the cord was immediately below the thyroid cartilage: the fingers were bent, and the

hands nearly clenched. His head was raised, the windows were thrown open, and blood abstracted from the arm, which was put into hot water, in order to increase the flow. In a few minutes the man began to breathe;—the bleeding was allowed to continue until the pulse was felt at the wrist, and the pupil contracted completely on the application of a lighted candle. The breathing was stertorous. Brandy and water were poured into the stomach, and warmth applied to the extremities. In the course of a few hours, he rallied very much,—his pulse had become firmer and quicker (130),—his head was hot,—he was very restless and unmanageable, and violently convulsed in the arms and legs. Shortly before death he became calm, and spoke several times. He suddenly became exhausted, and died nineteen hours after he was found hanging. The coroner *would not allow the body to be inspected*, and charged the medical practitioner with improper conduct in having opened a vein in the arm, instead of the temporal artery! This was probably a mixed case of asphyxia and apoplexy. The medical treatment appears to have been very proper. The unsuccessful result may perhaps be ascribed to the injury sustained by the cerebral circulation from constriction of the neck. Both in drowning and hanging, a person may in the first instance recover, but subsequently die in spite of the best treatment.

We learn from those who have been resuscitated, as well as from experiments performed by individuals upon themselves, that asphyxia comes on in the most insidious manner in death from hanging; and that the *slightest constriction* of the trachea will speedily produce insensibility. (Devergie, ii. 370.) The symptoms of which the persons have been conscious, were a ringing in the ears, a flash of light before the eyes, then darkness and stupor. The only profitable inference in a medico-legal view which can be drawn from observations of this kind is, that asphyxia is not only very rapidly induced, but that it supervenes under circumstances where it would not be generally expected to occur,—the body of the individual being in great part supported. M. Fleichmann found that a cord might be placed round the neck, between the chin and os hyoides, and tightened either laterally or posteriorly, without perceptibly interrupting respiration: but while the respiratory process was thus continuing, the face became red, the eyes prominent, and the head felt hot. These symptoms were followed by a sense of weight, a feeling of incipient stupefaction, and a hissing noise in the ears. On the occurrence of this last symptom, the experiment should be discontinued or the consequences may be serious. The first experiment lasted two minutes! but in the second, owing to the cord by its pressure more completely interrupting respiration, the noise in the ears appeared in *half a minute*. When the pressure was applied on the trachea, the effect was *instantaneous*, but on the cricoid cartilage it was not immediate. When it was applied between the os hyoides and the thyroid cartilage, or on the os hyoides itself, the period during which an individual could respire was extremely short; and this result was more striking when the act of expiration was performed at the moment of applying the pressure. The death of Scott, the American diver, in January 1840, shows how very readily asphyxia is induced by slight compression of the throat, even where a person might be supposed to have both the knowledge and the power to save himself. This man was in the habit of making public experiments on hanging, and had

frequently before, gone through them without danger; but on this occasion, it is probable that a slight shifting of the ligature from under the jaw-bone caused sufficient compression on the throat between the chin and larynx, as speedily to produce asphyxia. No attempt was made to save him until it was too late, and he was not brought to an hospital until thirty-three minutes had elapsed. He was allowed to hang thirteen minutes—the spectators thinking that the deceased was only prolonging the experiment for their gratification! It is not improbable that many persons have thus lost their lives by attempting these experiments in private, and their cases have been wrongly set down as cases of suicide. There is, I think, no doubt that boys have thus frequently but unintentionally destroyed themselves out of a strange principle of imitation or curiosity. In August 1844, a boy aged fourteen, witnessed an execution at Nottingham, and he was afterwards heard to say he should like to know how hanging felt. On the same afternoon, he was found suspended by a cord from a tree quite dead, and from the circumstances there could be little doubt that he had been experimenting on the theory and practice of hanging, and that he did not intend to destroy himself. The jury returned a verdict of "accidental hanging."

Post-mortem appearances.—The following are the external characters of the body which are laid down as indicative of hanging by most medico-legal writers. Lividity and swelling of the face, especially of the lips, which appear distorted. The eye-lids are swollen and of a blueish colour;—the eyes red, projecting forwards, and sometimes partially forced out of the orbitar cavities;—the tongue enlarged, livid and compressed between the teeth, or frequently protruded. The lower jaw is retracted. A sanguineous froth sometimes exists about the lips and nostrils. There is a deep and ecchymosed impression around the neck, indicating the course of the cord, the skin being occasionally excoriated;—laceration of the muscles and ligaments in the hyoideal region;—laceration or contusion of the larynx, or of the upper part of the trachea. There are also commonly circumscribed patches of ecchymosis varying in extent about the upper part of the trunk and the upper and lower extremities, with a deep livid discolouration of the hands. The fingers are generally much contracted or firmly clenched, and the hands and nails are livid. The urine and fæces are sometimes involuntarily expelled at the moment of death. Internally, we meet with the appearances described under the head of asphyxia. The right side of the heart and the great vessels connected with it, are commonly distended with blood. But when the inspection has been delayed for several days, this distension may not always be observed. The vessels of the brain are commonly found congested; and, in some rare instances it is said, extravasation of blood has been met with on the membranes and in the substance of the organ. Extravasation of blood is however so rare, that Remer found this appearance only once among one hundred and one cases; and in one hundred and six cases observed by Casper, it was not found in a single instance. The venous congestion of the

cerebral vessels is rarely greater than in other cases of asphyxia. In most instances there is increased vascularity of the substance of the brain, so that on making a section of the hemispheres, a greater number of bloody points than usual, will appear. In addition to these morbid changes, a mucous froth, sometimes of a sanguineous hue, has been described to exist in the trachea; but this is only likely to be met with in cases in which the obstruction to respiration has been incomplete. A more important circumstance has been noticed by Dr. Yelloly, namely, that in examining the stomachs of five criminals who had been hanged, he found great congestion in all; while there was blood extravasated and coagulated upon the mucous membrane in two. Such an appearance might, it is obvious, be attributed in a suspicious case to the action of some irritant substance. (See Ann. D'Hyg. 1830, 166. 1835, 208. 1838, 471.) These external post-mortem appearances have been chiefly derived from the examination of the bodies of executed criminals. Such well-marked characters are not generally met with in cases of *suicidal* hanging; and therefore it will be proper to state what are the principal differences. Thus, the face is sometimes pale—a condition commonly seen in those cases in which there has been but little obstruction to the cerebral circulation, either from the softness or looseness of the ligature. Esquirol found in one instance, that when the body was examined immediately after death, the face was not livid; but it first began to assume a violet hue in eight or ten hours. He thought that when the cord was left round the neck, the face would be livid; but, if removed immediately after suspension, pale. This view is not, however, borne out by observation. The tongue is not always protruded. Devergie found that there was protrusion of this organ, only in eleven cases out of twenty-seven. This protrusion was formerly supposed to depend upon the position of the ligature:—thus it was said when this was below the cricoid cartilage, the whole of the larynx was drawn upwards, and the tongue carried forwards with it, while, when above the os hyoides, the tongue was drawn backwards. The protrusion or non-protrusion of the tongue, does not depend upon any mechanical effect of this kind, but simply upon congestion; for it is occasionally met with thus protruding, in cases of drowning and in other forms of asphyxia. Besides, the protrusion has not been found to have any direct relation to the position of the ligature.

The most striking external appearance, however, is the *mark* produced on the neck by the ligature. The skin is commonly depressed and sometimes ecchymosed, but rarely throughout its whole extent: it is very frequently free from all traces of ecchymosis, the skin in the depression being then hard, brown, or of a *parchment colour* and consistency, or there may be only a thin line of ecchymosis in the upper or lower border of the depression. The course of the mark is generally oblique, being lower in the forepart than behind. If the noose should happen to be in front, the mark may be circular, the jaw preventing the ligature from rising upwards in the same degree before, as it com-

monly does behind. The mark is generally single, but we may meet with it double, as where the ligature has been formed into two circles or loops previously to its application. Its other characters will depend upon the nature of the ligature employed. Thus a large and wide ligature rarely produces ecchymosis,—the mark is wide and superficial, but a small ligature produces a narrow and deep depression, sometimes accompanied with laceration of the cuticle and effusion beneath the skin. From the statistical researches of Devergie and Casper, it would appear that a cord or rope is employed in more than one-half of all the cases of hanging which occur. In other instances various articles of dress were found to have been employed. Medical jurists have considered it proper to examine into the position of the ligature, as this may sometimes form a question in cases of suspected murder by hanging. The following table will show that in more than two-thirds of all cases of suicidal hanging, the ligature is found encircling the neck between the chin and os hyoides.

	Remer.	Devergie.	Casper.
Above the larynx	38	20	59
On the larynx	7	7	9
Below the larynx	2	1	0
	47	28	68

It was formerly believed, that the impression produced by the cord was invariably ecchymosed, but more correct observation has shown that this is probably the exception to the general rule. When ecchymosis does exist, it is commonly superficial and of very slight extent. There is rarely if ever effusion of blood in the cellular tissue. In individuals who have been criminally executed, it is not unusual to find ecchymosis, but even here it is not always present. In a case which I had an opportunity of examining some years since, there was only a slight trace of ecchymosis in one spot where the knot in the cord had produced contusion. That it should commonly occur in criminal executions, is not surprising, considering the violence employed on these occasions; but it has been somewhat too hastily assumed that these appearances in executed criminals, are met with in all cases of death from hanging. This doctrine has been carried so far, that a *livid mark* in the course of the cord has been pronounced to be the best criterion for distinguishing hanging in the living, from hanging in the dead body! It will be seen however, that no reliance can be placed on this appearance. In fifteen cases examined by M. Klein, in twelve examined by M. Esquirol, and in twenty-five cases of suicidal hanging which occurred to M. Devergie, there was no ecchymosis whatever in the course of the ligature, (ii. 394.) Annales D'Hyg. 1832, 413. 1842, 146. Out of six cases, Fleichmann met with only one instance. In three cases of suicidal hanging which I have had an opportunity of examining, no ecchymosis had been produced by the ligature. In all of these instances, the skin, instead of being blue or livid, or presenting effusion of blood in the cellular tissue beneath, was hard and of a *yellow colour* resembling parchment. It had that appearance which

the cutis commonly assumes, when the cuticle has been removed from it for two or three days; and on dissecting it off, the cellular membrane beneath often appears condensed and of a silvery whiteness. In some instances the mark, instead of being livid or brown, has presented itself simply as a white depression. This has been observed in very fat subjects. The observations of Casper on this point are as follows. Out of seventy-one cases, there was no ecchymosis produced by the cord in fifty; and thus in two-thirds of the cases examined, it was entirely absent. Casper also found that there was no difference in the result, whether the ligature were removed sooner or later after death. The following singular case which occurred to Dr. Hinze, of Waldenburg, will show that the presence of ecchymosis in the mark, does not depend on the ligature being left around the neck. A young man in a fit of drunkenness hung himself with a stout cord. In about half an hour afterwards, he was cut down, and attempts were made to resuscitate him. It was perceived that the cord had merely produced a superficial impression on the neck, destitute of any appearance of ecchymosis. Signs of returning life began to manifest themselves:—the attempts at resuscitation were continued for several hours, but all signs of vital reaction disappeared: and now, when life was about to become again extinct,—to the astonishment of those present, the mark on the neck which had been hitherto colourless, became deeply ecchymosed. On an inspection being made the next day, it was found that this ecchymosis continued; and that it was owing to a real subcutaneous effusion. From the appearances in the head, it was concluded that the deceased had died from congestive apoplexy. It should be mentioned that Remer considers ecchymosis in the course of the cord, to be a frequent appearance in hanging; but Devergie objects to the inference which he has drawn from his cases. (ii. 397.) Injuries to the muscles and deep-seated parts of the neck are of course only likely to be seen, where considerable violence has been used in hanging. In one or two instances, the lining membrane of the common carotid artery has been found lacerated. Congestion and tumefaction of the genital organs in either sex, have been set down among the common consequences of hanging,—but many observers have never met with these conditions; and it is doubtful whether, unless the body be examined speedily after suspension, any marked difference would be discovered. A more common sign perhaps is the discharge of the spermatic secretion in the male;—but according to Casper, it is the mucous secretion of the prostate gland, which is thus discharged at the moment of death taking place from hanging. He states that traces of this are met with in from one-third to one-fourth of all cases of death from hanging in the male. It appears to me that very little reliance can be placed upon evidence derivable from this sign, and yet it has sufficed to give rise to a most violent controversy among French medical jurists. (Ann. d'Hyg. 1839, i. 169. 467. ii. 393. 1840, ii. 314.) It is I think clear that unless death from hanging be pretty strongly established by other facts, neither the examination

of the linen of the deceased, nor the application of the microscope to the mucous fluid found in the urethra, would be of any practical value in elucidating the question, at least to the satisfaction of an English jury.

The following may be regarded as a *summary of the post-mortem appearances,* when death has taken place from asphyxia. The countenance is livid or sometimes pale, the eyes are prominent, the tongue congested, and occasionally protruded, the lower jaw retracted :—the skin is covered with patches of cadaverous ecchymosis, the hands are livid and clenched, an oblique mark is found on the neck,—sometimes presenting traces of ecchymosis, commonly, however, the skin is only brown in colour and hardened. The larynx, trachea, and subjacent muscles are lacerated, depressed, or discoloured. The vessels of the brain are congested, as well as those of the lungs and the right cavities of the heart. A mucous froth is occasionally found in the trachea. These appearances will of course be modified or they may be altogether absent when death has taken place from disorder of the cerebral circulation, or from injury to the spinal marrow, either by effusion of blood, fracture, or displacement.

WAS DEATH CAUSED BY HANGING?—When a person is found dead nd the body suspended, it may be a question whether death really ok place from hanging or not. In investigating a case of this kind, is necessary to draw a distinction between the *external* and *internal* ppearances of the body. The former alone can assist us in returning an answer to this question,—the internal appearances of the body can only enable us to say whether any latent cause of death existed or not. Neither the state of the countenance or skin, nor the position of the tongue, can afford any evidence on the subject of death from hanging. It is to the *mark* produced by the cord on the neck, that medical jurists have chiefly looked for the determination of this question. The form, position and other characters of this mark having been already described, it will be only necessary to allude to it, as furnishing evidence of life at the time of its production. It has been stated, that so far from being constantly livid or ecchymosed, this condition is in reality not seen in more than one half of the cases which occur. But admitting that we find ecchymosis in the course of the ligature,—are we always to infer that this must have been applied while the individual was living? According to the experiments of Devergie, it would appear that if a subject be hanged immediately, or a short time *after death,* an ecchymosed mark may be produced by the application of a ligature to the neck. (ii. 408.) If a few hours were suffered to elapse, so that the body had become cold, no ecchymosis was produced by the ligature. Professor Vrolik, of Amsterdam, found that a slightly livid mark was produced on the neck of a dead body, which was suspended *an hour* after death. (Casper Woch. Feb. 1838.) Hence this condition of the mark in a body found dead, indicates either that the deceased must have been hanged while living, or very soon after the breath had left his body. It would be for a jury to

decide between these two assumptions; and to consider why, when a man had really died from other causes, he should have been hanged in secrecy immediately after death! (See Ann. D'Hyg. 1842, i. 134.)

That the presence of active life is not required for the production of ecchymosis by the cord, appears to be established by the case reported by Dr. Hinze, (see ante, p. 590.) The circumstance that an ecchymosed mark may be produced by suspending a recently dead subject, bears out the statement of Merzdorff—that it would be in the highest degree difficult, if not utterly impossible, to determine medically by an inspection of the body, whether a man had been hanged while living, or whether he had been first suffocated and hanged up immediately after death. In making this admission, it is proper to bear in mind, that that which is difficult to a conscientious medical jurist, is often very easily decided by a jury from the general evidence afforded to them. Sometimes besides ecchymosis, there are excoriations of the skin in the course of the cord; and these are known to be *vital* by the effusion of blood, for Devergie never met with this appearance in the dead, even when the hanging took place immediately after death. The discovery of effused coagula in or about the deep seated layers of the neck, the larynx or trachea, or in or about the spinal column, would render it very probable that the deceased must have been hanged while living. Such marks of violence are, however, rare in cases of hanging; and when they are found, it might be assumed that the effusion and coagulation of blood had been caused by violence offered to the neck *immediately after death;* but this assumption may be met by the question already suggested, namely, why death by hanging should be simulated in the body of a person, who was alleged to have died from another cause!

With regard to the other, or more common kind of mark in suicidal hanging, it can scarcely be said to furnish any evidence in relation to the question which we are here considering. The depression may be hard and brown, although it does not usually acquire this colour until some hours have elapsed after death; for it appears to depend simply upon a desiccation of the portion of skin which has been compressed by the ligature. Sometimes the upper and lower borders only of the depression, present a faint line of redness or lividity; and it is worthy of remark, that when the ligature presents any knots or irregularities, those portions of skin which sustain the greatest compression are white, while those which are uncompressed may be found more or less ecchymosed. It is in this way that the form of the ligature, is sometimes accurately brought out. It may be remarked of these impressions produced by the cord, that the characters which they present are the same, whether the hanging take place during life or soon after death:—the appearances may be very similar in the two cases. The following experiments were performed by Casper.

1. A man, aged twenty-eight, was suspended an hour after death, by a double cord passed round the neck above the larynx. The body was cut

down and examined twenty-four hours afterwards. Between the larynx and os hyoides, there were two parallel depressions about a quarter of an inch deep—the skin having a brown colour with a slight tinge of blue, and a leathery consistency—in certain parts it was slightly excoriated. There was no extravasation of blood beneath, but the muscles which had undergone compression were of a dark purple colour, and the blood-vessels of the neck were congested. The appearance of this subject was such, that any individual unacquainted with the facts, would have supposed, on looking at it, that the person had really been hanged while living. There was nothing to indicate that the hanging had taken place an hour after death. 2. The body of another young man was hanged an hour after death, and an examination was made the following day. The two depressions produced by the double cord, were of a yellowish brown colour, without ecchymosis. The cutis appeared as if it had been burnt or cut, and felt like parchment. 3. An old man who had died from dropsy, was hanged two hours after death. The impressions presented exactly the same characters as in the preceding case. (Wochenschrift, für die G. H. Januar, 1837.)

When the constriction took place at a later period after death, there was no particular effect produced. We learn from these experiments, as well as from those performed by other observers, that the mark which is most usually seen in vital hanging, (non-ecchymosed,) is also produced by a ligature applied to the neck of a subject *within two hours* after death,—consequently the presence of this mark on the neck, is no criterion whether the hanging took place during life or after death. The changes in the skin beneath the mark, are also destitute of any distinctive characters: there is the same condensation of the cellular membrane whether the hanging have occurred in the living or a dead. These changes are the simple result of a physical cause,—mechanical compression. Thus then we draw the conclusion that there is no distinctive sign by which the hanging of a living person can be determined from an inspection of the dead body. All the external marks may be simulated in the dead subject, and the internal appearances furnish no evidence whatever. Still, when the greater number of the signs enumerated are present, and there is no other satisfactory cause to account for death, we have strong reason to presume that the deceased has died from hanging. We must not, however, abandon medical evidence on these occasions, merely because plausible objections may be taken to it. Facts may show that, however valid such objections may be in the abstract, they are wholly inapplicable to the particular case under investigation. Perhaps the greatest medical difficulties occur in reference to cases of suicide, owing to the slight appearances which here attend this form of death; but on these occasions, moral and circumstantial proofs are so generally forthcoming, that even an inspection of the body is scarcely ever deemed necessary by a coroner! If then it be admitted by a medical jurist, that it is not in all cases possible to distinguish hanging in the living from hanging in the dead, the admission must be considered as having reference to cases, wherein individuals destroy themselves, and not to cases where they are destroyed by others. Even if a doubt were raised in any particular instance, it is more than probable that circumstantial evidence would furnish data for a decision, and

thus satisfactorily make up for the want of ordinary medico-legal proofs.

If when we found a deeply ecchymosed mark around the neck of a dead subject, we said, all other circumstances being equal, that the individual had most probably died by hanging, we should not be departing from a proper discharge of our duty; since although it is medically possible that such a mark may be produced after death, yet as it would be only a murderer who would think of hanging up a recently dead body to simulate suicide, so it is certain, that in such a case we should most probably find some very obvious indications of another kind of violent death about the person. The absence of these, and the presence of ecchymosis in the course of the cord, would, it appears to me, leave the question of vital hanging decidedly settled in the affirmative. It is necessary that great caution should be used in expressing an opinion that the hanging probably took place after death, merely from the absence of ecchymosis in the seat of the ligature; because, while this is generally true, it may in particular cases lead to the concealment of the real mode of death. Many facts already adduced show that numerous cases of hanging during life, would be pronounced to be post-mortem, if this were taken as a criterion. The mere discovery of violence about the person, is not of itself sufficient to rebut the presumption of death from hanging on these occasions. The violence at least should be of such a nature as to account for the immediate destruction of life, or it can throw no light upon the question whether the individual might not have died from hanging, in spite of the marks of maltreatment about him. If in the case of a person found hanging, a medical jurist should assert that death had not taken place from that cause, this would be tantamount to declaring that the deceased must have been murdered:—because it is impossible to admit that any but a murderer would hang up a recently dead person. This has been frequently done for the purpose of concealing the real means of death and making the act appear to be one of suicide. The following case is reported by Deveaux. A female was found suspended to a beam in a barn. From the absence of all the marks of hanging about the face and neck of the deceased, a careful examination of the body was made. In the course of the inspection, a small penetrating wound evidently inflicted by a round instrument, was discovered on the right side of the chest, but in great part concealed by the mamma of that side. On tracing the wound, it was found to pass between the fifth and sixth ribs, completely perforating the heart from the right to the left side. A considerable extravasation of blood had taken place internally, which had been the cause of death. It was therefore evident from the result of this examination, that the deceased had been killed, and her body suspended after death. (For a precisely similar case by Prof. Vrolik, see Casper. Woch. Feb. 1838.) Foderé refers to a case in which an individual was found hanging under somewhat similar circumstances, and, on examination it was discovered that death had been caused by the administration of poison,—the body

having been subsequently suspended. In one instance Devergie discovered a quantity of plaster of Paris in the stomach and intestines of a person found hanging. There are, however, cases in which some embarrassment may occasionally arise. It may be a question whether the discovery of poison in a person found hanging, is not incompatible with previous attempts at suicide by poison. An individual has even been known to hang himself after or about the time that he had swallowed a strong dose of prussic acid. (See case, antè, p. 250.)

Circumstantial evidence has more than once assisted in clearing up a doubtful case. Louis states that on removing the body of a man who was found hanging, the rope was observed to be clotted with blood. This simple circumstance led to further investigation, by which it was discovered that the person had been murdered, and his body afterwards suspended. The presence of marks on the neck indicative of strangulation, such as the cord was not likely to have produced, may lead to a suspicion that the hanging followed death.

In April 1829, a boy was found hanging perfectly dead. On inspecting the body a round ecchymosed mark, about the size of a dollar, was seen on the fore part of the neck; and near it, were several impressions as of fingers in the surrounding skin. There was neither depression nor ecchymosis in the course of the cord. The inspection left no doubt that the deceased had died from asphyxia. It was subsequently discovered, that the boy had been first strangled and afterwards hanged. In another case a man was found hanging in a room. His body was so suspended from a hook in the door, that the trunk was not more than nine inches from the floor; and his legs were stretched out at length. The cord was from two to three feet long, and but loosely passed round the neck. The furniture of the room was in great disorder, and some marks of dried blood were seen on one part of the floor. The right side of the head and face of the deceased, presented several excoriated and ecchymosed marks. There was a circular impression around the neck produced by the cord; but it was entirely free from ecchymosis. On the left side, a little above this impression, there was a strongly ecchymosed mark, which could be traced round to the back of the head. Blood was found extravasated beneath this mark. The lungs presented the characters of asphyxia, but the examiners referred this to strangulation and not to hanging, considering that the body had been suspended after death to give the appearance of suicide. Had there been an ecchymosed mark on the neck, which could not have resulted from the suspending cord, the case would have remained medically speaking doubtful; because it is well known that the affirmative signs of hanging may be absent, and yet the individual may thus have died.

Marks of violence on the hanged.—The presence of marks of violence on the body of a hanged person, is important; and it will be proper for a witness to notice accurately their situation, extent, and direction. Having satisfied himself that they must have been received during life, he will have to consider the probability of their being of accidental origin or not. These marks of violence are not always to be regarded as unequivocal proofs of murder; for it is possible that they may have been inflicted by the individual himself before hanging, and not succeeding in committing suicide by these attempts, he may subsequently have resolved to accomplish his purpose by suspending himself. Let the witness duly reflect on these circumstances

before he allows his opinion to implicate any party,—let him consider that a hanged subject may bear the marks of a gun-shot wound, his throat may be cut, his person lacerated or disfigured, and yet before a suspicion of homicide is allowed to be entertained, it ought to be clearly shown that such injuries could not, by any probability, have been self-inflicted. The importance of observing caution in such a case will be still more manifest, when there is no ecchymosis produced by the cord, and the face does not present the usual characters of hanging. Marks of violence on a hanged subject, may in some cases be fairly ascribed to *accident*. If the individual have precipitated himself with any violence from a chair or table in a furnished apartment, he may have fallen against articles of furniture and have given rise to lacerations and contusions especially on the extremities. Again, it is possible to imagine with Dr. Male, that the rope may have given way, and the individual in falling, have injured his person; but he may afterwards have had resolution enough to suspend himself again. Such an occurrence may be rare; but when the presence of these injuries is made to form the chief ground of accusation against a party as the murderer, their accidental origin ought not to be lost sight of by a considerate witness. If we suppose the person to have been hanged in a state of intoxication or stupefaction, medical evidence alone will rarely suffice to determine the question of homicide or suicide. The absence of all marks of violence from the body might actually lull suspicion. It is proper on these occasions to look to the hands of the deceased, since it is with these that a person defends himself; and unless taken unawares, it is almost certain, if the hanging were homicidal, that there would be traces of violence on these parts. The clothes would be torn and discomposed, and the whole appearance of the deceased would be that of one who had done his utmost to resist a violent murderous attack. There are some injuries which could not be attributed to accident under the circumstances. Among these we may enumerate fractures, dislocations, deeply penetrating or incised, or gun-shot wounds. Now the question is, Do these serious injuries necessarily establish homicide? The answer must be in the negative:—although where fractures or dislocations exist, there are very strong grounds for suspicion. Suicides, it must be remembered, are capable of making many attempts on their lives by various means.

In the spring of 1836, a gentleman was found dead hanging in his bedroom at an inn. His dress was much disordered, and blood which had issued from a deep wound in his throat, was found scattered over the floor. From the facts proved, there was no doubt that this had been an act of suicide; and that the deceased, previously to hanging himself, had first attempted to cut his throat. Had his body been found in an exposed situation, this wound in the throat might have given rise to a suspicion of murder. The following somewhat remarkable case occurred at Walworth in 1836. A young man was found hanging in his bed-room, quite dead. He was suspended by his cravat, and his feet were within an inch of the floor. The door of the room was fastened on the inside, and it was proved that no one could have had access to it. An earthen pan was found near the bed, containing about a pint of blood, which appeared to have proceeded from a very deep

incision in the bend of the left arm of the deceased. The razor with which this had been inflicted, was found on the mantelpiece. It came out in evidence, that on the night previously, the deceased had swallowed a quantity of arsenic, and had suffered severely from the effects of the poison; although at the time, it was supposed that his illness was due to other causes. In this case, there were three modes by which suicide was attempted. The deceased had first taken poison, then wounded, and afterwards hung himself. There could be no doubt that death was caused by hanging, and had the wound been inflicted, and the poison administered by other parties, this opinion might have been safely expressed. Had the body been found hanging in a suspicious locality, these circumstances would have created a strong presumption of murder. An interesting case of this description will be found reported by M. Dégranges. (Ann. D'Hyg. 1835, ii. p. 410.) In one instance of suicidal hanging, there were lacerated wounds upon the head, and a handkerchief was found blocking up the mouth. (Henke's Zeitschrift, 1838, ii. 257; 1839, i. 207; also 1840, i. 135; also B. and F. Med. Rev. No. xxiv. p. 560.)

WAS THE HANGING THE RESULT OF ACCIDENT, HOMICIDE, OR SUICIDE?—Most medical jurists have passed over the subject of *accidental hanging*, probably believing it to be impossible. In the sense commonly implied by the term, it is certainly unusual, but although rare, it is a possible occurrence. Dr. Smith mentions a case which occurred some years since, in which a girl of the age of thirteen, was hanged by pure accident. She was swinging in a brewhouse, and near the rope used by her for that purpose, was another for drawing up slaughtered sheep. In the course of the exercise, her head got through a noose of this second cord, which pulled her out of the swing and kept her suspended at a considerable height, until dead. The following case was communicated to me by one of my pupils. In December 1833, an inquest was held on the body of a boy aged ten years. It appeared in evidence that he had been playing with a child eight years old, who was the only witness of his death. The deceased had been amusing himself in swinging, by fastening a piece of plaid gown to a loop in a cord which was suspended from a beam in the room. In the act of swinging he raised himself up, and gave himself a turn, when the loop of rope suddenly caught him under the chin, and suspended him until life was entirely extinct. The boy who was in the room with him, did not give any alarm for some time, thinking that the deceased was at play. The jury returned a verdict of "accidentally hanged." Another case occurred in London in 1836. A man who was in the habit of exercising himself in gymnastics on the rope, was one morning found dead and suspended in his bed-room. The rope had passed twice round the body and once round the neck, whereby it had caused death, although the legs of the deceased were resting on the floor. There was no doubt that the deceased had been accidentally hanged. These are two among several instances which have come within my knowledge, and it will be seen that the circumstances under which they occurred, were sufficiently decisive of the manner in which the hanging took place. Indeed circumstantial evidence must always suffice for the discrimination of accidental hanging; and we have there-

fore merely to inquire whether, when an individual is found hanging under circumstances which do not allow of the suspicion of accident, the act be the result of *suicide* or of *homicide*. The medical witness must remember that this is strictly a question for the jury. It is not for him to say whether a man has hanged himself or been hanged by others, but merely to state those *medical circumstances* which support or rebut one or the other presumption.

It has been very truly observed that of all the forms of committing murder, hanging is one of the most difficult, and it is, therefore, but seldom resorted to. In most cases where an individual has been hanged by others, it has been after death, in order to avert the suspicion of homicide. Hence the discovery of a person hanging, affords primâ-facie evidence of suicide, supposing it to be rendered probable, if not absolutely certain, that death has taken place in this manner. We must, however, admit that an individual may be murdered by hanging, and the appearances about his body will not afford the smallest evidence of the fact. The circumstances which will justify a medical jurist in making this admission, are the following. First, when the person hanged, is feeble, and the murderer a strong healthy man. In such a case, a child, a youth, a female, or an individual at any period of life, worn out and exhausted by disease or infirmity, may be in this way murdered Secondly, when the person hanged, although usually strong and vigorous, is at the time in a state of intoxication, stupefied by narcotics, or exhausted by his attempts to defend himself. Thirdly, in all cases, murder may be committed by hanging, when many are combined against one individual. With these exceptions, then, a practitioner will be correct in deciding in a suspected case, in favour of the presumption of suicide. Unless the person labour under stupefaction, intoxication, or great bodily weakness, we must expect in homicidal hanging, that there will be evident marks of violence about the body; for there are few who would allow themselves to be murdered without offering resistance, notwithstanding the assertion of Mahon, that some might submit to this mode of death with philosophical resignation, when they saw that resistance was hopeless! The following singular case of attempted murder by hanging, is mentioned in Syme's Justiciary Reports, Edinburgh, 1827. A woman, aged sixty-nine, was charged with attempting to hang her husband, who was some years older. It appeared that the prisoner contrived to twist a small rope three times round the neck of her husband, while he was lying asleep. She then tied him up to a beam in the room, in such a manner, that when the neighbours entered he was found lying at length on the floor with his head raised about one foot above it. He was quite insensible,—his hands were lying powerless by his side;—his face was livid, and it was some time before he could be roused. Had he remained three minutes longer in this position, he would have died. According to his statement, he went to bed quite sober, and he was not aware of anything which passed during the attempt to hang him or afterwards, until he was resuscitated. The

prisoner was convicted of the assault without previous malice, she having had no ill-will against her husband, and being at the time intoxicated. It can hardly be considered possible, that any man should be so sound asleep, as not to be awakened by the attempt thus made to hang him. The probability is, that the prosecutor was like his wife, intoxicated.

Some medical jurists have thought that the *mark* left by the cord on the neck, would serve as a criterion on which we might depend. Thus it has been said, if the mark be circular and placed at the lower part of the neck, it is an unequivocal proof of murder. In hanging, the mark of the cord is generally oblique, being higher at the back part of the neck, in consequence of the loop formed by it, yielding more in this direction than anteriorly. But it is an error to suppose that this want of obliquity in the impression, can afford any evidence in favour of the act having been homicidal. Its form will depend in a great degree upon the fact of the body being supported or not, for it is the weight of the body which causes its obliquity: it will also depend on the manner in which the cord is adjusted. A case of suicidal hanging, is related by Orfila in which the mark of the cord extended horizontally round the neck from behind forwards. (Méd. Lég. tome ii. p. 376.) The slip-knot of the cord was in front of the neck, and it is obvious that when the cord is thus adjusted by a suicide, there will be scarcely any obliquity in the depression produced by it. Equally ill-founded is the assertion, that the existence of *two impressions* on the neck, affords positive proof of homicide. One of these impressions, may be at the lower part of the neck and circular; the other at the upper part, and oblique;— it is therefore contended that the deceased must have been strangled in the first instance and afterwards hanged. The possibility of a prior attempt being made by a suicide to strangle himself is not adverted to,—"si l'on observe les deux impressions," says Mahon, "l'assassinat est alors parfaitement prouvé." It is fortunate that there are facts on record to oppose to this very decided statement. One of the first cases reported by Esquirol, is that of a female lunatic who committed suicide by hanging herself, and on whose neck, two distinct impressions were seen,—the one circular, the other oblique! These appear to have arisen from the cord having been passed twice round the neck,—the body being at the same time partially supported. In some instances, a presumption of homicidal interference may exist, if there be two distinct impressions, but it cannot be admitted that they establish the fact of murder.

The injury done to the neck by the cord, can rarely afford any clue to the manner in which hanging took place, unless the circumstances under which the body is found, favour the presumption of homicide or suicide. Thus the laceration of the muscles and vessels of the neck,—the rupture of the trachea and the displacement of the larynx, stretching of the vertebral ligaments, and effusion on the spinal sheath, may be observed in suicidal as in homicidal hanging. The presumption, however, is obviously in favour of the latter, when these violent inju-

ries are discovered, accompanied by fracture or displacement of the cervical vertebræ, and the body of the deceased is not corpulent,—the ligature, by which he is suspended, is not of a nature to produce them, and the fall of the body has not been great. A much disputed question has arisen in medical jurisprudence,—whether the cervical vertebræ can become fractured or displaced in suicidal hanging. Most medical jurists deny the possibility of this accident occurring,—the displacement or fracture of these vertebræ being rarely observed in criminal executions, where the greatest violence has been often used by the executioner. So far as I am aware, there is no case of *suicide* on record in which this injury to the neck existed. The case referred to by Petit, which was left to the decision of Dr. Pfeffer, is unsatisfactory because the body was not examined, and it is doubtful whether the act had really been one of suicide or not.

M. Ansiaux, of Liége, in inspecting the body of a woman who had hung herself, found extravasated blood behind the two first cervical vertebræ, which were more widely separated posteriorly than usual. On removing the vertebræ, the posterior ligament of the spine was found ruptured, and the transverse ligament of the atlas so stretched that the odontoid process of the second vertebra was completely locked against the articular surface. The perpendicular and oblique ligaments were entire. The deceased was a stout healthy person,—when discovered, her body was suspended from a beam at the distance of about a foot and a half from the floor. She had evidently fallen with considerable force. The case of this female will serve to show that severe injury to these deep-seated regions of the neck, may occasionally be met with in suicidal hanging. A case somewhat similar to this has been recently reported by Mr. Campbell de Morgan. (Lancet, Aug 10, 1844.) A married woman aged fifty, worn out and exhausted by disease, was found hanging quite lifeless from the rail of a bed, which was not more than five feet eight inches from the ground. The front of her body was turned round towards the bed, the head thrown forcibly back,—the knot of the ligature, an old silk hankerchief, being placed in the middle of the under side of the chin. Her heels were about three inches from the ground,—the knees being on a level with the bed-frame and resting against it. The body was seen by a medical man about an hour after it was cut down,—the features were perfectly calm, and there was no trace of congestion about the face: it was pale and in all respects natural. There was no lividity, the eyes were neither injected nor prominent,—the tongue pale, lying far back in the mouth and without any mark of indentation. The cord-mark well defined and like parchment, dry, brown and hard, without any ecchymosis, but with a thin line of congestion at the upper edge of the groove:—it was very deep at the back of the neck, just over the atlas, probably owing to the head hanging backwards. The mucous membrane of the stomach was pale,—the lungs natural, no congestion of the large veins or of the cavities of the heart; the two ventricles contained about an equal quantity of blood. These appearances seemed to show that death was not caused either by asphyxia or by cerebral congestion. Neither the trachea nor the great vessels of the neck could have sustained any pressure or constriction. The deep muscles over the second and third cervical vertebræ were ecchymosed,—this ecchymosis extended to the sheath of the spinal marrow, and on the left side and exterior to the sheath, there was an extensive effusion of blood firmly coagulated. There was no displacement of the dentata or other vertebræ, and the ligaments were sound; but between the third and fourth vertebræ, there was unusual mobility as if they had been stretched. In this case the body was not heavy, and the fall, if any, could have been but trifling. The effusion on the spinal marrow was the cause of death; and its origin was sufficiently ex-

plained by the falling back of the head and sudden bending of the cervical vertebræ. Her husband and family were in an adjoining room, but heard no noise: it was only by accident that the deceased was discovered.

In all doubtful instances, we should not lose sight of moral and circumstantial evidence. We should ascertain whether the individual had been previously disposed to commit suicide or not,—we should observe whether the doors and windows of the apartment be secured on the inside or on the outside,—whether the dress of the deceased be at all torn or discomposed, or his hair dishevelled,—lastly, whether the rope or ligature correspond to the impression seen around his neck. These points fall, it is true, more within the province of the officers of justice, than of a practitioner; but the latter is generally the first who is called to see the deceased, and therefore, unless such facts were noticed by him on his visit, they might often remain altogether unknown.

Lastly, it has been contended that the *position* of the body may serve to distinguish suicidal from homicidal hanging. This point was strenuously argued on the investigation which took place relative to the death of the *Prince de Condé* in 1830. According to the opinions of some of the witnesses on that investigation, if the body of a man be found in an inclined posture, or so suspended as that his feet are in contact with the floor, the idea of suicide by hanging is at once negatived,—we are rather to suppose that the person must have been otherwise destroyed, and his body afterwards placed in that position by his murderers. Here then we are called upon to admit that suicidal hanging is improbable, if not impossible, unless the deceased be found freely and absolutely suspended without any support! This very strong opinion, it will be seen, is not borne out by facts. In order that death should take place by hanging, it is not necessary that the body should be freely and perfectly suspended. Cases are of very frequent occurrence, where the bodies of hanged persons are found with the feet on the ground kneeling, sitting, or even in the recumbent posture. These are truly mixed cases of hanging and strangulation. I have now before me the reports of eleven cases of suicidal hanging or strangulation, which have occurred within the last few years. In three the deceased were found nearly recumbent, in four, in a kneeling posture, the body being more or less supported by the legs, and in four, the persons were found sitting. (For many singular cases of this kind with plates, see Annales D'Hyg. 1831, p. 157; 1830 i. 186; 1834, i. 472.) In one instance, the deceased was found on his knees at the foot of the bed, with his cravat round his neck, the other end being thrown over the bed-rail, and then twisted tightly round his right hand.

Among the cases collected by Esquirol, is the following. A patient in La Charité was found one morning hanging by a rope which was attached to the head of his bed. He had fastened this by a loop round his neck, but his body was so retained, that when discovered he was on his knees by the side of his bed. There are one or two other similar instances related by the

same author which I shall omit, and describe one that fell within my own knowledge. In 1832, at the west end of the town, a man was found hanging in his room, with his knees bent forwards and his feet resting upon the floor. He had evidently been dead for some time, since cadaverous rigidity had already commenced. The manner in which this person had committed suicide, was as follows,—he had made a slip-knot with one end of his apron, (he was a working mechanic,) and having placed his neck in this, he threw the other end of the apron over the top of the door, and shutting the door behind him, he had succeeded in wedging it in firmly. At the same moment, he had probably raised himself on tip-toe and then allowed himself to fall,—in this way he died. The weight of his body had apparently sufficed to drag down a part of the apron, for it seemed as if it had been very much stretched. (See also a case by Dr. Albert, Henke Zeitschrift 1843, ii. 50.)

Remer found that out of one hundred and one cases of suicidal hanging, in fourteen the body was either standing or *kneeling*, and in one instance it was in a *sitting* posture. Dr. Duchesne has recently published an account of fifty-eight cases in which the suspension of the body was partial, the feet or trunk being more or less supported. Twenty-six of these cases are new ;—he comes to the conclusion that *suicide* by hanging is compatible with *any posture* of the body even when resting upon the two feet. (Ann D'Hyg. Oct. 1845, 346.) Further evidence need not be adduced to show how unfounded is that opinion, which would attach the idea of homicidal interference, to cases where a body is loosely suspended or in contact with any support. We ought rather to consider this fact as removing all suspicion of homicide ; for there are few murderers who would probably suspend their victims either living or dead without taking care that the suspension was complete. Besides, all such cases are readily explicable ; —thus if the ligature be formed of yielding materials or loosely attached, it will give way to the weight of the body after death, and allow the feet to touch the floor, which they might not have done in the first instance. If there is reason to believe that the body has not altered its position after suspension, we must remember the facility with which insensibility comes on, and the rapidity with which death commonly ensues in this form of asphyxia. A most elaborate paper on this subject, illustrated by a large number of cases, has been lately published by M. Duchesne. (Ann. D'Hyg. 1845, ii. 141.) One or two other points are also worthy of notice in relation to this question. The hands or the legs, but more commonly the former, have been frequently found tied in cases of undoubted suicidal hanging (Ann. D'Hyg. 1832, i. 419 :) and yet it has been gravely debated, whether it were possible for a person to tie or bind up his hands and afterwards hang himself ! It is unnecessary to examine the ingenious arguments which have been urged against the possibility of an act of this kind being performed ; since among many cases that might be quoted, two occurred in 1843, in this metropolis, where the persons died from hanging,—the act was suicidal, and the hands were found tied in both instances with a silk handkerchief. A third case occurred at Worcester in December 1844, in which the deceased tied his wrists with a silk handkerchief and secured to this, two flat irons in order to increase the weight.

Again, it has been a debated question, whether *corporeal infirmity* or some peculiarity affecting the hands, might not interfere with the power of an individual to suspend himself. This question can only be decided by reference to the special circumstances of the case. In the case of the *Prince de Condé,* it was alleged that he could not have hanged himself, in consequence of a defect in the power of one hand,—it was said that he could not have made the knots in which the cravats by which he was suspended, were tied. Allegations of this kind appear to have been too hastily made in this and other instances. A determined purpose will often make up for a great degree of corporeal infirmity; and unless we make full allowance for this in suicide, we shall always be exposed to error in drawing our conclusions. Is *blindness* a bar to suicidal hanging? The answer is decidedly in the negative, not from theory but from actual facts; although some might be inclined to doubt whether a man labouring under such an infirmity, could really thus destroy himself. In February 1837, an inquest was held in London, on the body of a blind man, who was found dead, hanging in an outhouse. The evidence left not the smallest doubt of his having committed suicide. Connected with this, is the question how far weakness or infirmity from *age* may interfere with this form of suicide. Suicide under any circumstances among young subjects is rare. Out of one hundred and ninety-eight suicides, observed by M. Esquirol, at the Salpétrière, there were but two instances of subjects under fifteen years of age. (Ann. D'Hyg. 1836. ii. 400.) The youngest age at which I have met with a case of suicidal hanging, was in a boy of nine years who hung himself at Hampstead, in April 1837. The greatest age was the case of a man of ninety-seven, which occurred in September 1842. In a former part of this chapter, it has been stated that asphyxia in hanging is very insidiously induced, so that although the individual may appear to have the power of easily rescuing himself, yet this is impossible. The transition from life to death in such a case, is as rapid as it is imperceptible. This will explain why persons so readily die from slight constriction of the trachea, when their bodies are partly supported either standing, kneeling, or sitting:—why also it is not necessary that the cord or ligature should be drawn tightly round the neck; and lastly, why, as it has frequently happened, this form of suicide, should be easily perpetrated by persons labouring under disease or infirmity in a room where others are either present or near, but who are not aware of the act. This last circumstance has in more than one instance, given rise to an ill-founded suspicion of murder. When an individual has obviously died by hanging and the presumption of suicide is rebutted, or the act itself denied by a medical witness, the only alternative is, that it must amount to murder. It is not possible to conceive that the act of hanging another, can ever admit of justification or excuse. When in the case of death from drowning or wounds, it is doubtful whether the act should be referred to suicide or homicide, the admission of its having been homicidal, does not necessarily

cut off all hope from the offender. The deceased may have been drowned or wounded accidentally, or he may have been drowned or wounded intentionally; but under circumstances of great provocation. The act, therefore, may turn out to be a form of manslaughter. In hanging, however, the defence could never be that the act was accidental, nor is it possible to believe that the law would admit provocation as a justification for what must have been so deliberately done. The act itself, like poisoning, would be at once evidence of malice. With this knowledge then of what the absolute denial of suicide must lead to in a suspected case, a witness is bound to examine closely every medical presumption which can be construed in the least degree unfavourably to an accused party. One of the most remarkable cases on record is that of the *Prince de Condé*, which a few years since excited the attention of the medical jurists of France and England. It involves many of the questions connected with the medical jurisprudence of hanging. For a full account of this singular case, which was undoubtedly one of suicide, I must refer the reader to the Ann. D'Hyg. 1831, p. 157.

STRANGULATION.

CHAPTER LIV.

POST-MORTEM APPEARANCES. ACTS OF SUICIDE AND HOMICIDE.

Hanging and Strangulation are usually treated together, and some medical jurists have admitted no distinction in the meaning of these terms. In hanging, the phenomena of asphyxia take place in consequence of the *suspension* of the body, while in strangulation, asphyxia may be induced not only by the *constriction* produced by a ligature round the neck independently of suspension, but by the simple application of *pressure* through the fingers or otherwise to the trachea. It may indeed be said, that every individual who is hanged, is literally strangled; but hanging is only one form of strangulation, and sufficiently peculiar to claim a separate consideration. We have now, therefore, to direct our attention to the other means which have been employed to obstruct the respiratory process by external pressure on the trachea. These have commonly been arranged and treated under the head of manual strangulation. The *cause* of death is the same in the two cases, and the rapidity with which death ensues in strangulation, will depend in a great degree on the force employed, and on the complete-

ness with which the respiratory process is obstructed. In strangling, a much greater degree of violence is commonly employed than is necessary to cause asphyxia; and hence, the marks produced on the skin of the neck, will be, generally speaking, much more evident than in hanging, where the mere weight of the body is the medium by which the trachea is compressed.

The *post-mortem appearances* externally and internally are the same in strangulation as in hanging, but the injury done to the parts about the neck, is commonly greater in the former case than in the latter. If much force have been used in producing the constriction, the trachea, with the muscles and vessels in the fore-part of the neck, may be found cut or lacerated and the cervical vertebræ may be fractured. The mark of the ligature, if a ligature has been used, is generally circular and situated at the lower part of the neck. Instances have however, been related where a circular mark has been observed in hanging; and it is possible that some degree of obliquity may occasionally exist in the course of the depression produced by a ligature in strangulation. The medical jurist ought, therefore, to weigh all the circumstances connected with the position of the body and the direction of the ligature, before he forms an opinion whether the individual has been hanged or strangled. Much more importance is to be attached to the lividity, ecchymosis and abrasion of the skin in the course of the ligature, than to the circularity or obliquity of the depression produced by it. In the strangling of a living person by a cord, it is scarcely possible that a murderer should avoid producing on the neck, marks of violent injury; and in the existence of these, we have evidence of the manner in which death has taken place, which we cannot always expect to find in hanging. On the other hand, a person may be strangled, and yet the ligature, in consequence of its being soft and of a yielding nature, will not cause a very perceptible depression or ecchymosis. Such instances must, of course, be rare; because murderers usually produce a much more violent constriction of the neck than is necessary to ensure the death of their victims. (For an account of the appearances in a body thirty-eight days after interment, see Henke Zeitschrift, 1842, i. 236, ii. 310.) The medico-legal questions relative to strangulation, are of the same nature as those which have already been discussed in treating of hanging. Thus, in examining the body of a person, suspected to have been strangled, we may be required to answer the following question:

WAS DEATH CAUSED BY STRANGULATION, OR WAS THE CONSTRICTING FORCE APPLIED TO THE NECK AFTER DEATH?—The internal appearances of the body will yield no evidence, whereby the question can be solved; but the external appearances are commonly less ambiguous, than in a corresponding case of hanging. The ecchymosis about the depression on the neck, when a ligature has been employed, with the accompanying turgescence and lividity of the face, are phenomena not likely to be simulated in a dead body by the application of any degree of violence. When the constriction is produced within

a few minutes after dissolution, an ecchymosed depression may result; but it is improbable that there should be any lividity or turgescence of the countenance. Casper's experiments have established, that when the constricting force is not applied until *six hours* after death, no mark on the neck, resembling that formed on the living subject, is produced. It is difficult to conceive under what circumstances such an attempt to simulate strangulation in a recently dead body, could be made, unless for the purpose of throwing suspicion upon an innocent person connected with the deceased. When an individual has been murdered, it is not likely that the murderer would attempt to produce the appearances of strangulation on the body after death, under the idea of concealing his crime; for strangulation is in most cases a positive result of homicide, and is very rarely seen as an act of suicide. In the absence of ecchymosis from the neck, it will be difficult to form an opinion unless from circumstantial evidence. It must be remembered, however, that there may not always be an ecchymosed circle, for an individual may be strangled by the application of pressure to the trachea through the medium of the fingers or of any hard or resisting material. The ecchymosis in such a case will be in detached spots. In the absence of all marks of violence about the neck, we should be cautious in giving an opinion which may affect the life of an accused party; for it is scarcely possible that homicidal strangulation could be accomplished without the production of some appearances of violence about the larynx or trachea. The medical witness should be prepared to consider whether in such a case, death might not have proceeded from another cause, and leave it to the authorities of the law, to decide from circumstances in favour of, or against the prisoner. There is, I conceive, nothing to justify a medical witness in stating that death has proceeded from strangulation, if there should be no appearance of lividity, ecchymosis, or other violence about the neck or face of the deceased. The state of the countenance alone, will scarcely warrant the expression of an opinion; for there any many kinds of death in which the features may become livid and distorted from causes totally unconnected with the application of external violence to the throat. Let not a witness, then, lend himself as an instrument in the hands of a counsel for the condemnation of a person against whom nothing but a strong suspicion from circumstances may be raised, and where medical evidence is unable to throw any light upon the probability of death having resulted from strangulation. (See the trial of *Mrs. Byrne*, for murder, Dublin Commission Court, Aug. 1842.) This trial is full of interest to the medical jurist. Some post-mortem changes appear in this case to have been mistaken for marks of strangulation.

WAS THE STRANGULATION THE RESULT OF ACCIDENT, SUICIDE, OR HOMICIDE?—Cases of accidental strangulation are by no means uncommon. They have occurred from individuals carrying weights at their backs, supported by bands passing round the head or chest, the slipping of which has given rise to asphyxia, by compressing the trachea. In all cases of accidental strangulation, the position in which the body

is found, as well as other points of circumstantial evidence, must suffice to establish unequivocally the manner in which death really took place. When a charge of murder is instituted againt a party, an attempt is not unfrequently made by the counsel for the defence, to show the probability that the deceased might have fallen in a state of intoxication; and have become accidentally strangled by a tight cravat, or by any foreign body exerting pressure on the trachea. If we admit the possibility of an occurrence of this nature, we must not lose sight of the existence of other more probable modes of death, nor should we allow our judgment to be so swayed as to abandon what is probable for that which is merely possible. *Suicide by strangulation* must be regarded as of extremely rare occurrence, and except under particular circumstances, impossible. The possibility of an individual strangling himself, was for a long time denied by medical jurists; for it was presumed that when the force was applied by the hand, all power would be lost so soon as the compression of the trachea commenced. This reasoning, which is physiologically correct, is, however, only applicable to those cases in which the trachea is compressed by the fingers. When an individual, determined on suicide, allows the trachea to become compressed by leaning with the whole weight of his body on a ligature passed round his neck and attached to a fixed point, he may perish in this way almost as readily, as if he had hanged himself; for insensibility and death will soon supervene. In the chapter on hanging, it was stated that suicides were ofteu found with their bodies in close contact with the ground; and cases were referred to in which strangulation was accomplished in the manner above described, while the suicide was in a sitting or kneeling posture. On other occasions, the peculiar disposition of the ligature has enabled a suicide to strangle himself without much difficulty. An instance is related by Orfila, where two cravats, which were twisted several times round the neck of the deceased, who was discovered lying on his bed, had effectually served the purpose of self-destruction. (Méd. Lég. iii. p. 389.) Other cases are related in which suicides have succeeded in strangling themselves by tightening the ligature with a stick; or where this was formed of thick and rough materials, by simply tying it in a knot. (Ann. d'Hyg. 1829, 440. 1833. ii. 152; also a case by Dr. Simeons, Henke Zeitschrift, 1843. i. 355.) There are but few instances in which *suicidal* strangulation can be admitted to take place; and it would require a great deal of art and contrivance on the part of a murderer, so to dispose the body of his victim, or to place it in such a relation to surrounding objects, as to render the suspicion of suicide probable. Thus, if the ligature should be found loose or detached,—if the ecchymosis or depression should not accurately correspond to the points of greatest pressure,—if moreover, the means of compression were not very evident when the body was first discovered, and before it had been removed from its situation, there would be very fair grounds for presuming that the act was homicidal. In all those cases, where the strangulation has re-

sulted from compression of the trachea by the fingers, and where there are fixed ecchymosed marks, indicative of direct manual violence, we have the strongest presumptive evidence of murder; for neither accident nor suicide could be urged as affording a satisfactory explanation of their presence. (For a case of suicidal strangulation, see Brit. and For. Med. Rev. xiii. 261.) Strangulation does not often come before our Courts of law as a question of murder: and when a party has been tried upon a charge of this kind, the circumstances have been commonly so clear, as to have rendered the duty of a medical witness one of a very simple nature. Difficulties do, however, occasionally, arise, as may be seen by reference to the cases of the *Queen v. Taylor*, York Lent Assizes, 1842, and the *Queen v. Greek*, Salisbury Lent Assizes, 1843. See also the important case of the *Queen v. Reynolds*, Central Criminal Court, December 1842. Here it was left uncertain by the medical evidence, whether death was due to strangulation or malicious exposure to cold; and as the indictment only charged the former act, the prisoners were acquitted! (See likewise the case of the *Queen v. Fowles*, Stafford Lent Assizes, 1841.) For a full report of a case in which the question was, whether the deceased had committed suicide by hanging, or had been strangled by her husband, I must refer the reader to Cormack's Journal for April 1844, 344. The prisoner was acquitted on a verdict of "Not proven." An interesting case of alleged murder by strangulation (*Commonwealth* v. *Flanagan*) is reported in the American Jour. of Med. Sciences, Oct. 1845, p. 339.

SUFFOCATION.

CHAPTER LV.

CARBONIC ACID. CHARCOAL AND COAL VAPOUR.

When the respiratory process is impeded by any cause whioh operates independently of external pressure on the trachea, the iudividual is said to perish by suffocation. The circumstances under which suffocation may be induced are very numerous. Thus, a diseased state of the parts about the fauces,—the sudden bursting of a tonsillary abscess, the effusion of lymph or pus into the trachea or about the rima glottidis,—the presence of foreign bodies accidentally or forcibly introduced into the mouth,—may become so many causes of the sudden arrest of the respiratory function, the precise nature of any of which, a proper examination of the body will suffice to determine.

Two cases of great medico-legal interest have been lately reported of death from suffocation, produced by mechanical causes.—the one by Dr. Geoghegan, who has communicated to me the particulars, and the other by Dr. Jackson of Leith. Dr. Geoghegan's case was that of a boy who died in half an hour, under alarming symptoms somewhat resembling those of poisoning, and it appeared that a simple medicinal powder had been given to him about five minutes before the attack! On inspection the lower part of the trachea was found blocked up with cheesy scrofulous matter. It was evident that the child had died from asphyxia. Dr. Jackson's case is perhaps one of the most remarkable on record. A man, aged 31, was put to bed drunk, having previously vomited. Shortly afterwards he was found dead. On inspection, Dr. Jackson discovered the usual appearances of asphyxia, i. e. congestion of the lungs, and of the right cavities of the heart. He was thus led to examine the trachea carefully, and he found lying over the rima glottidis, a thin and transparent piece of potato-skin so closely applied to the fissure as to prevent respiration. The man had died suffocated from this mechanical cause. He had had potatoes for dinner the day before;—the piece of skin had probably been thrown up at the time of vomiting, and had been drawn back by inspiration into the singular position in which it was found. Owing to intoxication, the deceased was probably unable to cough it up. I agree with Dr. Jackson in thinking, that this case conveys a most important caution. In England, the verdict would most probably have been "Died by the visitation of God," without a post-mortem inspection! The result clearly shows, that in every case of sudden death, there should be a strict investigation of all parts of the body. (Ed. Med. and Surg. Jour. April, 1844, 390.)

Suffocation may be accidental or suicidal. Accidental deaths from this cause frequently occur from children drinking boiling water, (p. 10,) or from persons swallowing unusually large masses of food, from the deceased falling while intoxicated or helpless from infirmity into mud, feathers, ashes, or similar bodies. A singular instance of suffocation in a child, from a simple cause of this nature will be found in the Med. Gaz. xvii. 642. Suicidal suffocation from mechanical causes, is not very common, but some cases are recorded. A remarkable instance of this form of suicide is reported in the Ed. Med. and Sur. Journal, April 1842. In this case, the deceased forced a hard cotton plug into the back of the fauces. A similar case was the subject of an inquest in London, in September 1843. The deceased here had thrust into her throat a large piece of rag, which had been used for a lotion. She speedily died suffocated, and after death the rag was found lodged at the back part of the larynx. The internal organs in these cases, present no particular appearance indicative of the kind of death; they are very likely to be mistaken for cases of apoplexy, and they certainly show the necessity for a post-mortem examination in every instance of sudden death. (See Ed. Med. and Sur. Jour. liv. 149; also, Med. Chir. Rev. xxviii. 410.) The case of *Reg. v. Haywood,* Lancaster Sum. Ass. 1839, shows how easily a defence of apoplexy may be sustained in a case of alleged murder by suffocation. Without strong circumstantial evidence, it would be difficult to establish homicide in these cases.

In a medico-legal point of view, asphyxia, induced by the operation of any of these causes of suffocation, is of far less importance, than that which is a consequence of the respiration of certain gases unfitted

for the support of life; it is, therefore, chiefly to the effect produced on the system by these agents that we must direct our attention in treating of death by suffocation. The numerous *gases* with which chemists are acquainted, are found to vary materially in their operation when introduced into the lungs; and a division has been established among them into those which have a *negative*, and into those which have a *positive* action. The former alone can be considered to cause death by asphyxia or *suffocation*; for those which have a positive influence, must be regarded as poisons. Now experiment has shown that there are but two gases, which are essentially negative in their operation,—these are hydrogen and nitrogen; all the others have a poisonous action when introduced into the body. Indeed with regard to hydrogen, some doubt may be fairly entertained respecting its claim to be considered as a truly negative agent; for the researches of Allen and Pepys in this country, and the observations of Wetterstedt in Sweden, have shown that this gas cannot be substituted for nitrogen in atmospheric air, without inducing somnolency and lethargy. (Berzelius. Traité de Chimie, vol. vii. p. 106.) If, then, we admit that the greater number of the gases are poisonous, it is scarcely correct to regard these bodies as purely asphyxiating agents. The state of lifelessness which follows their introduction into the lungs, is not to be ascribed to the simple negation of air, as in the case of drowning, hanging, or strangulation; but to a deleterious impression produced on the system, something analogous in its effects to that which is observed to follow the ingestion of a poisonous dose of hydrocyanic or oxalic acid. The difference is, that the poison is aërial, and applied to the surface of the lungs instead of the stomach; but strictly speaking, a person is no more suffocated by carbonic acid, than he is by arsenuretted hydrogen. (See ante, p. 146.) Nevertheless, as the medico-legal history of these poisonous gases has nothing in common with that of poisons in general, they may be treated in the present chapter as suffocating media, according to the common view of their action on the body.

The greater number of these gases are never likely to be met with in the atmosphere so abundantly as to produce injurious consequences. They are chiefly complex products of art;—hence fatal accidents, arising from their inhalation, most commonly occur under circumstances which can leave no question respecting the real cause of death. The peculiar effects of all these, it will be unnecessary to describe; but there are two, a knowledge of the properties and operation of which, may on certain occasions be required of a medical jurist,—these are the *Carbonic acid* and *Sulphuretted hydrogen gases*. Agents of this description can scarcely be employed as instruments of murder; and if they were so employed, the fact could only be established by circumstantial evidence. Death, when arising from the respiration of either of these bodies, is generally attributable to suicide or accident. In France, it is by no means uncommon for individuals to commit self-destruction by sleeping in a closed apartment, in which charcoal has been

suffered to burn; while in England, accidental deaths are sometimes heard of, where coal has been employed as fuel in small and ill-ventilated rooms. On such occasions, a person may be found dead without any apparent cause to the casual observer,—the face may appear tumid and discoloured, and the cutaneous surface may be covered with ecchymosed patches. The discovery of a body under these circumstances, will commonly be sufficient, in the eyes of the vulgar, to create a suspicion of murder; and some individual, with whom the deceased may have been at that period on bad terms, will, perhaps, be pointed out as the murderer. In such a case, it is obvious that the establishment of the innocence of an accused party, may depend entirely on the discrimination and judgment of a medical practitioner. An instance, illustrative of the consequences of this popular prejudice, occurred in London in the year 1823. Six persons were lodging in the same apartment where they were all in the habit of sleeping. One morning an alarm was given by one of them, a female, who stated that on rising she found her companions dead. Four were discovered to be really dead, but the fifth, a married man, whose wife was one of the victims, was recovering. He was known to have been on intimate terms with the female who gave the alarm, and it was immediately supposed that they had conspired together to poison the whole party, in order to get rid of the wife. The woman who was accused of the crime was imprisoned; and an account of the supposed murder was soon printed and circulated in the metropolis. Many articles of food about the house, were analyzed, in order to discover whether they contained poison, when the whole of the circumstances were explained by the man stating that he had placed a pan of burning coals between the two beds before going to sleep, and that the doors and windows of the apartment were closed. (Christison, p. 583.) Another interesting case of a similar kind has been lately reported in the Medical Gazette, by Mr. Smith, of Liverpool. (Vol. xxxvi. p. 937.) See post p. 616.

Carbonic acid.—This gas is freely liberated in respiration, combustion and fermentation; it is also extricated in the calcination of chalk or limestone, and is abundantly diffused through the shafts and galleries of coal-mines, where it is commonly called choke-damp. Carbonic acid gas is likewise met with in wells, cellars, and other excavations in the earth. In these cases it is found most abundantly generally on the soil, or at the lower part of the well; and it appears to proceed from the decomposition of animal and vegetable matters confined in such situations. The slow evaporation of water strongly charged with the gas, while trickling over the sides of these excavations, may likewise assist in contaminating the air. Damp sawdust or straw slowly extricates carbonic acid.

Symptoms.—The symptoms of poisoning by this gas, will vary according to the degree of concentration in which it is present in the atmosphere when respired. When it exists in a fatal proportion, the symptoms commonly observed are as follows:—A sensation of great

weight in the head, giddiness, a sense of constriction in the temporal regions, a ringing in the ears, with a pungent sensation in the nose; a strong tendency to sleep, accompanied by vertigo, and so great a loss of muscular power, that if the individual be at the time in an erect posture, he instantly falls as if struck to the ground. The respiration, which is observed to be at first difficult and stertorous, becomes suspended. The action of the heart, which on the first accession of the symptoms is very violent, soon ceases. Sensibility is lost and the person now falls into a state of profound coma, or apparent death. The warmth of the body still continues; the limbs remain flexible, but sometimes they have been observed to become rigid, or even occasionally convulsed. The countenance is commonly of a livid or of a deep leaden colour, especially the eyelids and lips, but on some occasions it is stated to have been pale. The access of these symptoms has been sometimes accompanied by a pleasing sensation of delirium, while at others the most acute pains have been suffered. In some instances there appears to have been irritability of the stomach, for the affected person has rejected the contents of his stomach in a semi-digested state. Those who have been resuscitated, have often felt pain in the head, or pain and soreness over the body for several days; while, in a few severe cases, paralysis of the muscles of the face has supervened on recovery.

POST-MORTEM APPEARANCES.—Externally, the whole of the body appears as if it were swollen, especially the face, which is generally livid, and the features are much distorted. The cutaneous surface is covered in parts by patches of a violet hue, but in some instances the skin has been extremely pale; the eyes are generally prominent, and, in many cases, retain their usual brilliancy for some time after death. The body of an individual who has perished from the inhalation of carbonic acid, is said to retain the animal heat, cæteris paribus, for a longer period than usual; and hence, according to Orfila, cadaverous rigidity does not commonly manifest itself until after the lapse of many hours. In a case to be related presently, the body was however found to have cooled considerably in the short space of two hours. On making a post-mortem inspection, the venous system is found filled with blood of a dark colour, and the vessels of the lungs and brain are observed to be especially in a state of congestion. The tongue appears swollen, and it is stated by Orfila, that the mucous membrane of the intestinal canal is often interspersed with dark ecchymosed patches.

ACTION ON THE BODY.—Some difference of opinion still exists respecting the manner in which carbonic acid acts on the body. Sir Humphrey Davy ascertained that carbonic acid, in a perfectly pure state, did not pass into the trachea, when an attempt was made to respire it; the glottis seemed to close spasmodically at the moment that the gas came in contact with it. On diluting the carbonic acid with about twice its volume of air, he found that he could breathe it; but it soon produced symptoms of vertigo and somnolency. In fact, in a diluted state, it is certain that it must penetrate into the lungs, or

otherwise it would be impossible to explain why it should produce any other symptoms on the economy, than those witnessed in the inhalation of hydrogen or nitrogen. The facts which have been collected by Dr. Christison show, in a striking point of view, that carbonic acid is a real and energetic poison of the narcotic kind. If, as Nysten supposed, it had a negative effect when respired, it ought to follow, that it might be substituted for nitrogen, in the proportion in which that gas exists in atmospheric air. But a mixture of carbonic acid and oxygen, in atmospheric proportions, has been shown by M. Collard de Martigny, to produce rapidly fatal effects upon the animal system. Such a mixture cannot be breathed even for a period of two minutes, without giving rise to serious symptoms.

When the gas enters into the pulmonary cells, it is probably absorbed by the blood, and circulated with that fluid throughout the body. Its specific action on the brain may be inferred from the headache, vertigo, somnolency and coma, which follow its introduction, as also from the loss of muscular power in persons labouring under its effects, and the paralysis which is sometimes seen in those who have recovered. A very small proportion of carbonic acid, when respired for a certain time in combination with air, will suffice to destroy life in man or in any of the higher orders of animals. It is generally admitted by physiologists, that an atmosphere containing more than *one-tenth* of its volume of carbonic acid will, if introduced into the lungs, speedily prove fatal to human life. M. Guérard has lately called in question the general opinion that carbonic acid is very fatal to life. He says it may be mixed in very large proportions with atmospheric air without causing death, and attributes the noxious effects of charcoal vapour to carbonic oxide, which he says will prove fatal when in the proportion of only four or five per cent. (Annales D'Hygiéne, 1843, ii. 54.) If M. Guérard had extended his experiments to the Grotta del Cane, at Pozzuoli, near Naples, he would have found that mixtures which he describes as innocent, are speedily fatal to animal life. The air of the grotto is a mixture of carbonic acid, common air, and aqueous vapour,—it contains no carbonic oxide; and I have not only witnessed its effects on animals, but have myself experienced the incipient symptoms of poisoning by carbonic acid from respiring it.

It is necessary in these cases to make a distinction between the contamination of air from the admixture of free carbonic acid, and the case where the carbonic acid is formed by combustion or respiration in a close apartment, at the expense of the oxygen actually contained in air. Every volume of carbonic acid formed by combustion, indicates an equal volume of oxygen removed. Such an atmosphere is, cæteris paribus, more destructive than another where the air and gas are in simple admixture. If we assume that in each case the noxious atmosphere contains ten per cent. of carbonic acid, then in one instance there will be seven per cent. more of oxygen than in the other, as will be seen by the following tables:—

	Free carbonic acid and air in admixture.	Carb. acid from comb. or respir. and air.
Nitrogen . .	. 72	79
Oxygen . .	. 18	11
Carbonic acid .	. 10	10
	100	100

This difference in the proportions may not be, practically speaking, correct; because there is no apartment sufficiently closed to prevent air rushing in from the exterior, while combustion is going on within it; but, nevertheless, the above statement may be taken as an approximation to the truth. When the gas is respired in the lowest poisonous proportion, the symptoms come on more slowly, and the transition from life to death is frequently tranquil; this is what we learn from the histories of suicides. The symptoms in such cases appear to resemble closely those which indicate the progressive influence of opium, or any other narcotic poison on the body.

TREATMENT.—The best means for resuscitation are the employment of cold affusion, with stimulating embrocations to the chest and extremities. If the surface be cold, a warm bath should be employed, and on the appearance of any signs of recovery venesection may be performed. If at hand, oxygen gas may be introduced into the lungs. A case, in which the use of this gas is said to have been successful, is quoted in the Lancet, July 26, 1844, p. 531. (See ante p. 569, DROWNING.) Oxygen gas was used for this purpose nearly forty years ago by the late Dr. Babington. (Med. Chir. Trans. i. Art. 8.)

CHARCOAL VAPOUR.—The gas extricated during the combustion of charcoal, according to the experiments of Orfila, is not pure carbonic acid, but a very compound mixture. It operates fatally when respired, chiefly in consequence of the carbonic acid contained in it, the proportion of which, however, is subject to variation, according to whether the combustion be vivid or not. When the charcoal burns vividly, the quantity of carbonic acid is less than when the charcoal is either nearly extinguished or beginning to burn. In the former case, the carbonic acid is in the proportion of about eleven per cent. by volume—in the latter, the proportion amounts to about fourteen per cent.; the remainder of the mixture is made up of air, of free nitrogen, and of a portion of carburetted hydrogen, if the charcoal be not too intensely ignited. (Orfila.)

The following case, illustrating the effects of charcoal vapour, has been reported by Mr. Collambell. (Med. Gaz. xxvii. 693.) In January, 1841, a man was engaged to clean the windows of three small rooms on the basement story of a house. The first room had a door opening into a court-yard—the others merely communicated with each other by a central door, and there was no fire-place in any one. A brazier of burning charcoal had been placed in the outer room for the purpose of drying it, but it appeared that the deceased had shut the outer door, and had removed the brazier into the inner room of the three, leaving the communicating doors open. In two hours the man was found quite dead, lying on the floor of the

middle room. The countenance was pale, as well as the whole of the skin; the eyes were bright and staring, the pupils widely dilated; the lips exsanguine; the jaw firmly fixed; the tongue protruding, and the face and extremities cold. Some frothy mucus had escaped from the mouth. The person who discovered the deceased, found the ashes in the brazier still burning, and he experienced great oppression in breathing. An inquest was held without an inspection, and a verdict of accidental death returned. The body was afterwards privately inspected by Mr. Collambell. On opening the head, the vessels on the surface of the brain were found highly distended with dark liquid blood: the pia mater was bedewed with serum. The brain was of unusually firm consistence, and numerous bloody points appeared on making a section of it. The lateral ventricles were distended with about an ounce and a half of pale serum, and the vessels of the plexus choroides were much congested. The cerebellum was firm, and presented on section numerous bloody points. About two ounces of serum, tinged with blood, were collected from the base of the skull. The lungs had a slate-colour On the left side of the chest there were eight ounces of serum, tinged with blood; and nearly an equal quantity on the right side. On cutting into the organs, a large quantity of serous fluid, mixed with blood, escaped. The bronchial tubes were filled with a frothy fluid, tinged with blood. The pericardium contained an ounce of pale serum. The heart was enlarged; the cavities contained no blood. The liver and kidneys were much distended with blood There was no doubt that the cause of death was the inhalation of carbonic acid; and it is probable that the man died from respiring but a comparatively small proportion. The capacity of the chambers must have nearly reached two thousand cubic feet; the man had been there only two hours, and when the person who discovered him entered the rooms, the air was not so vitiated but that he could breathe, although with some oppression. The fuel was then in a state of combustion.

It often excites surprise on these occasions that no exertion is made to escape, when it would apparently require but very slight efforts on the part of the individual. The fact is, that the action of carbonic acid is sometimes very insidious; one of its first effects is to create an utter prostration of strength, so that even on a person awake and active, as in the case just related, the gas may speedily produce a perfect inability to move or to call for assistance. For some good remarks on the action of charcoal vapour by Dr. Bird, see Guy's Hospital Reports, April 1839; and for a case illustrative of the dangerous effects of the diluted vapour, see Ed. Med. and Surg. Jour. l. 541. In this instance, a charcoal brazier was left only for a short time in the cell of a prison. It was removed, and the prisoners went to sleep. They experienced no particular effects at first, but after some hours, two were found dead. Thus, then, an atmosphere which may be breathed for a short time with impunity, may ultimately destroy life. The slow combustion of *wood* may also give rise to dangerous consequences. (See cases by Devergie, Ann. D'Hyg. 1835, i. 442.)

The remarks of M. Devergie, on the effects of smouldering wood, have been recently confirmed by two cases published by MM. Bayard and Tardieu. A man and his wife were found dead in bed. There was a smoky vapour in the apartment, but no fire had been lighted in the grate, and the chimney was blocked up. The planks of the floor were widely separated, and there was a large hole in the boards at the foot of the bed, communicating with the apartment below. It was found, on examination, that some joists connected with the flue of an iron plate, which had been heated for making confec-

tionary the previous day, were in a smouldering state; that the vapour had entered the bedroom of the deceased through the crevices in the floor, and not finding a vent through the chimney, had led to these fatal results. It is remarkable that the source of combustion was nearly nine yards distant, and one person, who slept nearer to the flue of the iron plate, entirely escaped. In the husband the skin was of a reddish tint, the blood liquid, the cavities of the heart empty, the lungs gorged, and no subpleural ecchymoses. In the wife, there was less redness of the skin, the blood was coagulated in the cavities of the heart principally on the right side, extending to the vessels; less engorgement of the lungs, and a great number of subpleural ecchymoses, indicating that strong efforts had been made to respire. There was at first a rumour of poisoning, which was only removed by a close examination of the locality. (Ann. D'Hyg. Oct. 1845, 369.)

Coal-vapour.—The gases extricated in the smothered combustion of coal are of a compound nature. In addition to carbonic acid, we may expect to find in the atmosphere of a close room, in which such a combustion has been going on, sulphurous acid gas, and the sulphuretted and carburetted hydrogen gases. These emanations are equally fatal to life, but in consequence of their very irritating properties, they give warning of their presence, and therefore are less liable to occasion fatal accidents. The sulphurous acid gas, when existing in a very small proportion in air, has the power of irritating the glottis so violently, that, if accidentally respired, it would commonly compel the individual to leave the spot before the vapours had become sufficiently concentrated to destroy life. Nevertheless, accidents from the combustion of coal sometimes occur.

The following cases will convey to the practitioner a knowledge of the symptoms and post-mortem appearances which are commonly met with on these occasions. A few years since, four individuals, in a state of asphyxia, were brought to Guy's Hospital. It appeared that on the evening before, they had shut themselves up in the forecastle of a coal-brig, and had made a fire. About six or seven o'clock the same evening, some of the crew accidentally placed a covering over the flue on the outside, and thus stopped the escape of the smoke from the fire, which was made of a kind of coal containing much sulphur. Early in the morning one of the crew, on opening the hatches, observed three of the inmates lying on the floor senseless, and frothing at the mouth; the fourth in his crib, in a similar condition. The air in the place was most offensive. After the unfortunate persons were brought on deck, one of them, aged twenty-one, began to recover, and when brought to the hospital, seemed only giddy, as if intoxicated He soon completely recovered. Another, aged forty, after breathing oxygen gas, and having brandy and ammonia exhibited, scarcely showed any symptom towards restoration, and died in a few hours. A third, aged seventeen, soon began to rally, and, after a few hours, was perfectly enabled to answer any questions; he declared that he felt no pain, sense of oppression or weight, either in his head or chest. The fourth, aged fifteen, died the following day, having exhibited no symptom of rallying. Stimulants were administered internally, and warm fomentations were used, but all efforts to produce reaction failed. The appearance of the individuals, when brought in, was as follows:—lips purple, countenance livid, surface of the body cold, hands and nails purple, respiration very quick and short; pulse small, quick, and feeble; pupils fixed, and total insensibility. The body of the man, aged forty, was inspected about four hours after death. The membranes of the brain were congested, and there was a large quantity of fluid under the tunica arachnoides. The sinuses were gorged with blood. The lungs were in a state of great conges-

tion, as also the right cavities of the heart. It was remarked, that this corpse was similar in appearance to that of an executed culprit. The body of the lad, aged fifteen, was inspected about thirty-three hours after death. Under the pia mater was observed one small ecchymosed spot; in the substance of the brain there were more bloody points than usual: a small quantity of fluid was found under the tunica arachnoides, and the sinuses were full of coagulated blood. The lungs showed no congestion, but the right cavities of the heart were much distended with blood. (For an account of two cases of recovery from the effects of coal-vapour, see Med. Gaz. ix. 935.)

It will be seen that in all these cases there is nothing very characteristic in the post-mortem appearances, and thus it is always easy to ascribe death to apoplexy or some other cause; but it should be remembered that carbonic acid itself acts by inducing apoplexy or cerebral congestion. A stove was actually allowed to be patented a few years since—the principle of which was to allow of the escape of the products of combustion in an invisible form into an apartment! There were many so ignorant as to believe, that because the fumes were invisible they were inert; others speculated upon the quantity of carbonic acid evolved being small. The use of this stove appears to have led to the death of a man named Trickey, in St. Michael's church, in 1838, and many other serious accidents. The case of *Trickey* is in many respects worthy of the attention of the medical jurist. See Lancet, Nov. 1838.

In the burning of *lime*, carbonic acid is given out very abundantly and in a pure form. It has been owing to the respiration of the gas, thus extricated, that persons who have incautiously slept in the neighbourhood of a burning lime-kiln during a severe winter, have been destroyed. The discovery of a dead body in such a situation would commonly suffice to demonstrate the real cause of death; but a practitioner ought not to be the less prepared to show that there existed no other apparent cause of death about the person. It is obvious that an individual might be murdered, and his body placed subsequently near the kiln by the murderer, in order to avert suspicion. If there be no external marks of violence, the stomach should be carefully examined for poison; in the absence of all external and internal lesions, medical evidence will avail but little; for a person might be criminally suffocated, and his body, if found under the circumstances above stated, would present no appearances upon which a medical opinion could be securely based. An accident is related by Foderé to have occurred at Marseilles in 1806, where seven persons of a family were destroyed in consequence of their having slept on the ground-floor of a house, in the court-yard of which a quantity of limestone was being burnt into lime. They had evidently become alarmed, and had attempted to escape; for their bodies were found lying in various positions. The court-yard was enclosed, and the carbonic acid had poured into the apartment through the imperfectly-closed window and door. In November 1838, a man died three days after being exposed to the vapours of a lime-kiln. (G. H. Rep. April 1839.) The vapour of a brick-kiln is equally dele-

terious, the principal agent being carbonic acid, although I have found that ammonia and muriatic acid are also abundantly evolved. In September, 1842, two boys were found dead on a brick-kiln near London, whither they had gone for the purpose of roasting potatoes. Although the cause of death in the two cases was clearly suffocation, in one instance the body was extremely livid, while in the other there was no lividity whatever! Such accidents are very frequent. In November, 1844, an inquest was held at Manchester on the body of a man who had died under similar circumstances.

CONFINED AIR.—An animal confined within a certain quantity of air, which it is compelled to respire, will soon fall into a state of lifelessness. A human being in the same way may be suffocated, if confined in a close apartment where the air is not subject to change or renewal, and this effect is hastened when a number of persons are crowded together in a small space. The change which air, thus contaminated by respiration, undergoes, may be very simply stated. The quantity of nitrogen in a hundred parts will remain nearly the same, the quantity of oxygen will probably vary from eight to twelve per cent., while the remainder will be made up chiefly of carbonic acid. Such air will also have a high temperature, if many persons are crowded together, and will be saturated with aqueous vapour containing animal matter poured out by the pulmonary and cutaneous exhalants. From this statement, it is evident that air which has been contaminated by continued respiration, will operate fatally on the human system, partly in consequence of its being deficient in oxygen, and partly from the deleterious effects of the carbonic acid contained in it. The proportion in which carbonic acid exists in respired air must be subject to great variation; according to the experiments of Allen and Pepys, it never exceeds ten per cent. by volume of the mixture, how frequently soever it may have been received into and expelled from the lungs. Dalton found that the air in crowded rooms contained about one per cent. of carbonic acid, the atmospheric proportion being therefore increased tenfold. It is certain that insensibility and death would ensue in a human adult, before the whole of the oxygen of the confined air had disappeared; but the opportunity can rarely present itself of analysing such a contaminated mixture, and hence it is impossible to specify the exact proportion in which carbonic acid would exist, when the confined air had proved fatal to persons who had respired it.

CHEMICAL ANALYSIS.—Sometimes a medical jurist may be required to state, for the purposes of justice, the nature of the gaseous mixture in which a person may have died. He will have but little difficulty in determining whether carbonic acid is the deleterious agent in such a mixture. When it exists in a confined atmosphere, its presence may be identified, if previously collected in a proper vessel, by the following characters. 1. It extinguishes a taper if the proportion be above twelve or fifteen per cent.; and from the extreme density of the gas, the smoke of the extinguished taper may be commonly seen to float on its surface. 2. Lime-water, or a solution of subacetate of lead, is instantly precipitated white when poured into a jar of the gas, and the precipitate thus formed, may be collected by filtration, and proved to

possess the well-known properties of carbonate of lime or lead. Air containing only one per cent. of carbonic acid scarcely affects lime water. 3. When a solution of chloride of lime, coloured by litmus, is added, the blue colour on agitating the liquid in the gas, is discharged This clearly distinguishes carbonic acid from nitrogen. The *proportion* in which carbonic acid exists in a mixture, may be determined by introducing into a given quantity in a graduated tube over mercury, a strong solution of caustic potash. Absorption will take place after a certain time, and the degree of absorption will indicate the proportion of carbonic acid present. When this destructive agent exists in a confined spot, as in a well or cellar, it may be generally got rid of by placing within the stratum a pan containing the hydrate of lime, loosely mixed into a paste with water, or by exciting combustion at the mouth of the pit. Lives are often successively lost on these occasions, one individual descending after another, in the foolish expectation of at least being able to attach a rope to the body of his companion. The moment that the mouth falls within the level of the stratum, all power is lost and the person commonly sinks lifeless. The gas may be collected by lowering a bottle filled with fine sand by means of a string attached to the neck, guiding the bottle by another string attached to its base. When the bottle is within the stratum it should be turned with its mouth downwards, then rapidly raised with its mouth upwards, by pulling the string attached to the neck. The best test for *sulphurous acid* in cases of suffocation by coal-vapour is a mixture of iodic acid and starch, which speedily acquires the blue colour of iodide of farina. This colour, however, is entirely discharged by long exposure.

Combustion in mixtures of carbonic acid.—In concluding this account of carbonic acid, there is one other circumstance which deserves to claim our attention. It is a matter of very popular belief, and, in fact, it is generally asserted by writers on asphyxia, that the burning of a candle in a suspected mixture ef carbonic acid and air, is a satisfactory proof that it may be respired with safety. Recent observations have, however, tended to show that this statement is not to be relied on as affording an indication of security. A case is related by Dr. Christison, where a servant, on entering a cellar in which grape-juice was fermenting, was suddenly seized with giddiness. She dropped her candle on the floor, but had time to leave the cellar and shut the door behind her, when she fell down senseless. Those who went to her assistance found, on opening the door, that the candle was still burning. Another case is referred to, where, in an attempt at suicide, on entering the apartment, the person was discovered to be in a state of deep coma, while the pan of charcoal was still burning; and in an instance just now reported, the same fact was observed. In order to ascertain how far reliance was to be placed upon this popular sign of the salubrity of the air, the following experiments were made:—

1. Twenty-two cubic inches of carbonic acid were mixed with one hundred and ninety eight cubic inches of air. The mixture was allowed to stand four days, in a mean temperature, and was occasionally agitated in order to promote the equable diffusion of the gas. On introducing a lighted taper or candle into this mixture, it continued to burn without any perceptible diminution in the brilliancy of its flame. 2. Twenty cubic inches of carbonic acid were mixed with one hundred and forty of air After allowing the mixture to remain four days, a taper was introduced into the jar, and it burnt with very slight diminution in the intensity of its flame. 3. Twenty c. i. of carbonic

acid were mixed with sixty c. i. of air. The taper was introduced into this mixture on the fifth day, and it was found that it continued to burn until it reached the bottom of the jar, which was about fifteen inches in depth. Here the flame was perceptibly less brilliant, and after a few seconds, it became extinguished. In repeating this last experiment several times the flame was, however, immediately extinguished. These experiments, then, show that a candle will burn in air which is combined with ten, or twelve and a half per cent. of its volume of carbonic acid gas: and although such mixtures might not prove immediately fatal to man, yet they would soon give rise to giddiness, vertigo, insensibility and ultimately death, in those who, after having been once immersed in them, did not hasten to quit the spot. In air containing a smaller proportion than this,—five or six per cent., a candle will readily burn, but it is probable that such a mixture could not be long respired without causing fatal symptoms. One point may seem to require explanation, relative to the results of these experiments. The air which is contaminated by frequent respiration, was stated, resting on the observations of Allen and Pepys, never to contain more than ten per cent. by volume of carbonic acid; but it is well known that such air will not support the combustion of a taper, a fact which may seem opposed to the results of the experiments above mentioned. In respired air, however, there is a deficiency of oxygen, and a proportional excess of nitrogen. The quantity of oxygen is, therefore, not sufficient to maintain the combustion of the taper, hence it becomes extinguished; but that oxygen is still present may be proved by plunging into the mixture ignited phosphorus, which will burn in air in which a candle is extinguished, and produce the well-known pyrophosphoric acid vapours. The asphyxiating atmosphere of a confined apartment, in which charcoal or coal has been burnt, may not contain so much as twelve per cent. of carbonic acid, and yet a candle will be immediately extinguished in it. The explanation above given is also here applicable, for in such an atmosphere there is necessarily a deficiency of oxygen and an excess of nitrogen.

The burning of bodies in gaseous mixtures of this kind appears to depend more on the quantity of oxygen present, than on the proportion of carbonic acid in them; and from the results of experiments, it seems doubtful whether carbonic acid really possesses that strong counteracting influence to the active combustion of bodies which some have represented. In a mixture of air and carbonic acid, where the latter amounts to fifty per cent., most combustible bodies, if we except phosphorus, are instantly extinguished; but if fifty parts of common oxygen be well mixed with fifty parts of carbonic acid, a candle and other combustibles will burn most brilliantly in such a mixture, so that it would hardly be inferred that any carbonic acid was present. I have even found a candle to burn, though less brilliantly, in a mixture of twenty-five parts of oxygen, and seventy-five parts of carbonic acid. When, however, the oxygen formed only one-fifth part, or twenty per cent. of the mixture, the flame of a candle was immediately extinguished. In any of these cases, it cannot be doubted that life would have been speedily destroyed by the respiration of such mixtures, and the facts appear to show that the *burning of a candle can be no criterion of safety* against the effects of carbonic acid. It is perfectly true that in gaseous mixtures where a candle is extinguished, it would not be safe to venture, but the converse of this proposition is not true; namely, that a mixture in which a candle burns, may be always respired with safety. The last experiment justifies the inference, that carbonic acid has some slight positive effect on the burning of bodies; for it was here in the proportion in which nitrogen exists combined with oxygen in the atmosphere, and yet it is obvious that with respect to ordinary combustion, it could not be substituted for nitrogen.

DIFFUSION OF CARBONIC ACID.—Of late years some important medico-legal questions have arisen, relative to the diffusion of this gas in air when produced by combustion. It has been supposed that owing to its great specific gravity, (1·527,) it would collect on the floor of an apartment, would gradually rise upwards and suffocate individuals at different times, according to the

level on which they might be placed. Questions on this point have been variously answered, and great difference of opinion has arisen on the subject. Medical witnesses have often lost sight of two important points on which a correct answer to a question of this kind must be based,—1. the law of the diffusion of gases, and 2. the effect of heat in greatly diminishing the specific gravity of a gas naturally heavy. There is no doubt, that in a narrow or confined vessel, carbonic acid is slow in escaping,—nevertheless it mixes and passes off with the air;—and in the course of an hour or two, in spite of its great specific gravity, none will be contained within the vessel. The well-known Grotta del Cane at Pozzuoli, has been quoted by those who hold that carbonic acid always tends to remain on the lowest level,—but it has been forgotten that in this, and other like cases, carbonic acid is continually issuing from crevices in the soil, to replace that which is lost by diffusion; hence the illustration proves nothing. It may suffice to state, that air and carbonic acid mix readily on contact in all proportions, although they enter into no chemical combination; and if we even place a vessel containing hydrogen, a gas much lighter than air, over another containing carbonic acid, after two or three minutes, this body will be found, by appropriate tests, to have mixed with the hydrogen, and the hydrogen to have mixed with the carbonic acid. Thus, then, at common temperatures, carbonic acid has no tendency to remain on the floor or soil, when there is a free access of air or contact with other gases. The heat of combustion diminishes the specific gravity of the gas, and the carbonic acid therefore ascends with the heated current of air, and diffuses itself in the upper part of an apartment, when there are no means for carrying it off. This is a fact demonstrable by many simple experiments. In burning a quantity of charcoal actively in an open brazier raised above the floor in a large apartment, I found the following to be the mean result of several analyses of the air, collected one foot above the level of the burning fuel, and one foot below the level of the source of combustion, there being no currents to affect the results.

	Above the fuel.	Below the fuel.
Carbonic acid	4·65	4·5
Air	95·35	95·5
	100·	100·

These results appear to show that the carbonic acid of combustion has no particular tendency to collect at the lowest level; but that it is really uniformly diffused around, and probably it would be found by careful experiments that within apartments of small dimensions—those in which individuals are often accidentally suffocated—the upper strata of air contain as much or even more carbonic acid than the lower. For this reason, an apartment with a low ceiling is more dangerous under these circumstances, than one which is high-pitched.

In a very large apartment it would of course be improper to test the suffocating properties of the air, by the examination of it at a great distance from the source of combustion; since a person situated near this spot might be destroyed, while one at a distance might escape—the carbonic acid not having completely diffused itself: or supposing it to have become entirely diffused, the proportion may be so small as to render it harmless. It is well known, by the effects of the vapour of a lime-kiln, that one lying at the edge of the kiln may be destroyed, while another at ten yards distance, either on the same level or below it, may entirely escape; nor would it be possible, in such a case, to speculate upon the proportion of carbonic acid which had here destroyed life, except by collecting the air from the spot where the accident occurred, and at or about the time of its occurrence. Another fallacy appears to be, that because a dead body is found recumbent it is inferred that the individual must have lain down and have been destroyed while sleeping. The body of a dead person must always be found thus lying on the floor, unless it be supported; but suffocation may actually have taken place, or at least have

commenced, while the person was in the sitting or erect posture. Admitting that carbonic acid diffuses itself rapidly in a heated current from combustion in a small and closed apartment, it has been supposed that after having become mixed with the air, it would again in great part separate, and fall to the lowest level on cooling by its superior density. In answer to this, it may be said, 1. That there are no facts to support this opinion, while there are many against it; for we do not find that the heaviest and lightest gases, when once really mixed, ever again separate from each other 2. Practically this explanation amounts to nothing; because before the gas had cooled and re-acquired its density, its asphyxiating properties would probably have had their full effect on all living persons within its reach. Persons are not suffocated by carbonic acid after the fuel is extinguished, and the apartment cooled; but the poisonous action of the gas is commonly manifested, while the fuel is still burning. The inferences which, it appears to me, we are entitled to draw from the preceding considerations, are, 1. That in a small and close apartment individuals are equally liable to be suffocated at all levels, from the very equal and rapid diffusionof carbonic acid during combustion. 2. That in a large apartment, unless the gas is very rapidly diffused by a draught of air, the air around the source of combustion may become impregnated with a poisonous proportion, while that at a distance might be still capable of supporting life, because carbonic acid requires time for its perfect and equable diffusion in a very large space.

In an interesting case of alleged murder by carbonic acid, which occurred in Paris a few years since, a question was put to the medical witnesses, respecting the quantity of charcoal required to be burnt in a particular chamber to asphyxiate two adult individuals. (Ann. D'Hyg. 1837, i. 201; 1840, 176; also Brit. and For. Rev. xi. 240. and xxiii. 264.) This question could of course only be answered approximately; because in burning charcoal, the sole product is not carbonic acid, and the substance itself is by no means pure carbon. Then again, much of the carbonic acid formed may escape in various ways from an imperfectly closed apartment. An attempt was made to infer the quantity of charcoal consumed from the weight of ashes found in the apartment; but no satisfactory answer could be given to this question. The prisoner was, however, convicted of murdering his wife by carbonic acid.

CHAPTER LVI.

SULPHURETTED HYDROGEN. DRAINS AND SEWERS. COAL-GAS. SMOTHERING.

Sulphuretted hydrogen.—This gas, in a medico-legal point of view, may be considered next in importance to carbonic acid. Individuals are occasionally accidentally killed by it; but the very offensive odour which a small portion of it communicates to a large quantity of air, is sufficient to announce its presence and to prevent any dangerous consequences from taking place. The sulphuretted hydrogen gas, when respired in its pure state, is almost instantaneously mortal. It exerts equally deleterious effects upon all orders of animals, and upon all the textures of the body. It is found to destroy life, even when it is allowed to remain in contact with the skin. Mr. Donovan states that a rabbit enclosed in a bladder of sulphuretted hydrogen gas, but

allowed to breathe freely in the atmosphere, perished in ten minutes. When introduced into the lungs of animals, even in a very diluted state, it has been known to give rise to fatal consequences. Thus, Thénard found that air which contained only one eight-hundredth of its volume of this gas, would destroy a dog, and that when the gas existed in the proportion of one two-hundred-and-fiftieth, it sufficed to destroy a horse. The later researches of M. Parent Duchâtelet would, however, seem to show that the poisonous effects of the gas have been somewhat exaggerated, at least in the application of these results to man. He observed that workmen breathed with impunity, an atmosphere containing one per cent. of sulphuretted hydrogen, and he states that he himself respired, without serious symptoms ensuing, air which contained *three per cent.* In most drains and sewers, rats and other vermin are found to live in large numbers; and, according to Gaultier de Claubry, the air in those localities contains from two to eight per cent. (Devergie, ii. 520.) Thus, admitting it to be a poison, even more powerful than carbonic acid, it does not appear to be so energetic as Thénard's experiments would lead us to suppose. An atmosphere containing from six to eight per cent. of the gas, might speedily kill, although nothing certain is known of the proportion required to destroy human life. One fact, however, is worthy of the attention of medical jurists, namely, that the respiration of an atmosphere, only slightly impregnated with the gas, may, if long continued, seriously affect an individual, and even cause death.

M. D'Arcet had to examine a lodging in Paris, in which three young and vigorous men had died successively, in the course of a few years under similar symptoms. The lodging consisted of a bedroom with a chimney, and an ill-ventilated ante-room. The pipe of a privy passed down one angle of the room by the head of the bed, and the wall in this part was infiltrated. At the time of examination there was no perceptible smell in the room, although it was small and low. M. D'Arcet attributed the mortality in the lodging to the slow and long-continued action of the emanations from the pipe; and it is highly probable that this was the real cause. (Ann. D'Hyg. Juillet, 1836.) The men who were engaged in working at the Thames tunnel, suffered severely during the excavation from the presence of this gas in the atmosphere in which they were obliged to work. The case was referred to me for examination by Sir M. I. Brunel, in 1839. The air as well as the water was found to contain sulphuretted hydrogen, which trickled through the roof. It was probably derived from the action of the water on the iron pyrites in the clay. The gas issued in sudden bursts, so as to be at times perceptible by its odour. By respiring this atmosphere, the strongest and most robust men, were in the course of a few months reduced to an extreme state of exhaustion, and several died. The symptoms with which they were first affected, were giddiness, sickness and general debility; they became emaciated and fell into a state of low fever, accompanied by delirium. In one case which I saw, the face of the man was pale, the lips of a violet hue, the eyes sunk with dark areolæ round them, and the whole muscular system flabby and emaciated. Chloride of lime and other remedies were tried for the purification of the air; but the evil did not entirely cease until the tunnel was so far completed, that there was a communication from one side to the other, and free ventilation throughout.

Symptoms.—The symptoms produced by sulphuretted hydrogen on

the human system, vary according to the degree of concentration in which it is respired. When breathed in a moderately diluted state, the person speedily falls inanimate. An immediate removal to pure air, venesection, and the application of stimulants, with cold affusion, may, however, suffice to restore life. According to the account given by those who have recovered, this state of inanimation is preceded by a sense of weight in the epigastrium and in the region of the temples, also by giddiness, nausea, sudden weakness and loss of motion and sensation. If the gas in a still less concentrated state, be respired for some time, coma or tetanus with delirium supervenes, preceded by convulsions or pain and weakness over the whole of the body. The skin, in such cases, is commonly cold, the pulse irregular and the respiration laborious. When the air is but very slightly contaminated by the gas, it may be breathed for a long time without producing any serious symptoms; sometimes there is a feeling of nausea or sickness, accompanied by pain in the head or diffused pains in the abdomen. These symptoms are often observed to affect those who are engaged in chemical manipulations with this gas. Sulphuretted hydrogen appears to act like a narcotic poison when highly concentrated; but like a narcotico-irritant when much diluted with air. It is absorbed into the blood, to which it gives a brownish black colour, and it is in this state circulated throughout the body.

Post-mortem appearances.—On examining the bodies of persons who have died from the effects of sulphuretted hydrogen, the following appearances have been observed. The mucous membrane of the nose and fauces, is commonly covered by a brownish viscid fluid. A highly offensive odour is exhaled from all the cavities and soft parts of the body. These exhalations, if received into the lungs of those engaged in making the inspection, sometimes give rise to very unpleasant symptoms, and even to syncope or asphyxia. The muscles of the body are of a dark colour, and are not susceptible of the galvanic stimulus. The lungs, liver, and the organs generally are distended by black liquid blood. There is also great congestion about the right side of the heart, and the blood is said not to become coagulated after death. The body rapidly undergoes the putrefactive process. The most common form of accidental poisoning by sulphuretted hydrogen, for it is rare that a case occurs which is not purely accidental, is witnessed in nightmen and others who are engaged in cleaning out drains and sewers, or in the removal of the soil of privies. These accidents are much more frequent in France than in England, the soil being often allowed to collect in such quantities in Paris and other large continental cities before any attempt is made to remove it, that it becomes a highly dangerous occupation for the workmen. According to the results of Thénard's observations, there are two species of compound gases or mechanical mixtures of gases, which are commonly met with in the exhalations of privies. The first compound consists of a large proportion of atmospheric air holding diffused through it, in the form of vapour, the hydrosulphuret of ammonia. The hydrosulphuret is con-

tained abundantly in the water of the soil, and is constantly rising from it in vapour, and diffusing itself in the surrounding atmosphere. It is this vapour which gives the highly unpleasant odour, and causes an increased secretion of tears in those who unguardedly expose themselves to such exhalations.

The *symptoms* produced by the respiration of this gaseous mixture, when in a concentrated state, bear a close resemblance to those described as resulting from the action of sulphuretted hydrogen gas. If the person be but slightly affected, he will probably complain of nausea and sickness, his skin will be cold, his respiration free but irregular; the pulse is commonly frequent, and the voluntary muscles, especially those of the chest, are affected by spasmodic twitchings. If more seriously affected, he loses all power of sense and motion, the cutaneous surface becomes cold, the lips and face assume a violet hue, the mouth is covered by a sanguineous mucus, the pulse is small, frequent, and irregular; the respiration hurried, laborious, and convulsive; and the limbs and trunk are in a state of general relaxation. If still more severely affected, death may take place immediately; or should the person survive a few hours, in addition to the above symptoms, there will be short but violent spasmodic twitchings of the muscles, sometimes even accompanied by opisthotonos. (See Ann. D'Hyg. 1829, ii. 70.) If the individual be sensible, he will commonly suffer the most severe pain, and the pulse may become so quick and irregular that it cannot be counted. When the symptoms are of such a formidable nature, it is very rare that a recovery takes place. The appearances met with on making a post-mortem examination of the body, are similar to those produced by sulphuretted hydrogen. The inspection should be made with caution, for a too frequent respiration of the poisonous exhalations, may seriously affect the practitioner. TREATMENT.—The same as in poisoning by carbonic acid.

CHEMICAL ANALYSIS.—The recognition of these gases is a very simple operation. The odour which they possess is sufficient to determine their presence even when they are diluted with a large quantity of atmospheric air. The sulphuretted hydrogen gas is at once identified by its action on paper previously dipped in a soluble salt of lead: if present even in very small proportion, the moistened paper speedily acquires a brownish black stain from sulphuret of lead. The sulphuretted hydrogen may be also thus proved to exist in the vapour of hydrosulphuret of ammonia mixed with air; and the presence of ammonia is indicated in the compound by the volatile alkaline reaction on test-paper, also by holding in the vessel containing the vapour recently collected, a rod dipped in strong muriatic acid; the production of dense white fumes announces the formation of muriate of ammonia. It is a fact which cannot be too universally known, that a candle will readily burn in a mixture of either of these bodies with air, which, if respired, would suffice to destroy life. (Ann, D'Hyg. 1829, ii. 69.) It is also worthy of remark, that the air of a cess-pool may be often respired with safety until the workmen commence removing the soil, when a large quantity of mephitic vapour may suddenly escape, which will lead to the immediate suffocation of all present. Several persons have been killed by trusting to the burning of a candle, in ignorance of this fact. The best plan for getting rid of the gas is by a free exposure of the locality, or by exciting active combustion in it. According to Parent Du-

châtelet, men can work in an atmosphere containing from two to three per cent. of sulphuretted hydrogen. The air of one of the prlncipal sewers of Paris gave the following results on analysis ln 100 parts: oxygen, 13·79; nitrogen, 81·21; carbonic acid, 2·01; sulphuretted hydrogen, 2·99.

There is another species of deleterious compound present in these exhalations of a very different nature. It is more rarely met with than the preceding, and consists, according to Thénard, in one hundred parts, of ninety-four parts of nitrogen, two of oxygen, and four of carbonic acid gas. Sometimes the carbonic acid gas is combined with ammonia, and then it may be regarded, chiefly, as a mixture of nitrogen holding diffused through it the vapour of carbonate of ammonia, which is sufficient to render it highly irritating to the mucous membrane of the eyes and nose. Its action on the human body when respired, will be readily understood from this statement of its chemical composition. In its operation, it must be regarded as exerting an influence essentially negative; for the small proportion of carbonic acid, or of carbonate of ammonia existing in it, cannot be supposed to give rise to the asphyxia which so rapidly follows its inhalation. The chances of recovery are much greater in persons who become asphyxiated from the inspiration of this compound, than in those who are exposed to the influence of the preceding. Commonly the immediate removal to a pure air is sufficient to bring about a recovery; for the asphyxia is originally induced, owing to there being an insufficient portion of oxygen in the mixture to sustain life. Should death take place, it will be found on a post-mortem inspection, that the internal appearances are the same as those which are met with in the examination of the bodies of the hanged or the drowned.

Chemical analysis.—This compound extinguishes a taper:—the carbonic acid contained in it, may be removed by caustic potash, and then it will be seen that the great bulk of the mixture is formed by nitrogen,—a gas which by its negative properties cannot be easily confounded with any other. In a mixed atmosphere of carbonic acid and sulphuretted hydrogen, the two bodies may be separated by agitating the mixture with a solution of acetate of lead, nd treating the precipitate with acetic acid, which dissolves the carbonate, and leaves sulphuret of lead.

Coal-gas.—Since the introduction of coal-gas for the purposes of illumination, many fatal accidents have occurred from the respiration of air contaminated with it. Coal-gas is a very compound body, acting as a direct poison;—its composition is subject to much variation, according to circumstances. The following are the results of two analyses:

	Mitscherlich.	Tourdes.
Proto-carb. hyd.	56·	22·5
Hydrogen	21·3	31·
Carbonic oxide	11·	21·9
Bicarb. hyd. and pyrelain	7·	6·
Nitrogen	4·7	14·
Carbonic acid	—	4·6
	100·	100·

The difference depends on the heat to which the gas has been submitted. The analysis of M. Tourdes is interesting, because the respiration of this mixture led to the death of five persons. Some consider that carbonic oxide is the poisonous principle; but there is no doubt that the hydrocarbons also have a noxious influence, although the use of the safety-lamp in mines proves that a mixture of protocarburetted hydrogen with air in a small proportion, may be respired without producing serious effects.

SYMPTOMS.—The symptoms produced by coal-gas when mixed in a large proportion with air, are vertigo, cephalalgia, nausea with vomiting, confusion of intellect with loss of consciousness, general weakness and depression, partial paralysis, convulsions and the usual phenomena of asphyxia.

POST-MORTEM APPEARANCES.—These will be best understood from the following cases:—

In January 1841, a family residing at Strasburg, respired for forty hours an atmosphere contaminated with coal-gas which had escaped from a pipe passing near the cellar of the house where they lodged. On the discovery of the accident, four of the family were found dead. The father and mother still breathed, but in spite of treatment, the father died in twenty-four hours; the mother recovered. On a post-mortem examination being made of the five bodies, there was a great difference in the appearances; but the principal points observed, were congestion of the brain and its membranes—the pia mater gorged with blood,—and the whole surface of the brain intensely red. In three of the cases, there was an effusion of coagulated blood on the dura mater of the spinal canal. The lining membrane of the air-passages was strongly injected; and there was spread over it a layer of thick viscid froth tinged with blood; the substance of the lungs was of a bright red colour, and the blood was coagulated. (M. Tourdes, Ann. D'Hyg. Jan. 1842.) In two cases, communicated by Mr. Teale to the Guy's Hospital Reports, (No. viii.) there was found congestion of the brain and its membranes, with injection of the lining membrane of the air-passages. In these cases, the blood was remarkably liquid. The circumstances under which the accident occurred, were very similar. An old lady and her grand-daughter, who had been annoyed by the escape of gas during the day, retired to bed, and were found dead about twelve hours afterwards.

In the cases above given, the *effects* produced by coal-gas were owing to its long-continued respiration. The quantity contained in the air of the rooms must have been very small;—in M. Tourdes' case, it was probably not more than 8 or 9 per cent., because a little above this proportion the mixture with air becomes explosive, and there had been no explosion in this case, although in the apartment in which the individuals were found dead, a stove had been for a long time in active combustion, and a candle had been completely burnt out. In Mr. Teale's case, those who entered the house perceived a strong smell of coal-gas; but still the air could be breathed. Coal-gas, therefore, like other aërial poisons, may destroy life if long respired, although so diluted as not to produce any serious effects in the first instance. This gas owes its peculiar odour to the vapour of hydrocarbon:—the odour begins to be perceptible when the gas forms the 1000th part;—it is easily perceived when forming the 700th part, but the odour is

well-marked when it forms the 150th part (Tourdes). In most houses where gas is burnt, the odour is plainly perceived; and it is a serious question, whether health and life may not often be affected by the long-continued respiration of an atmosphere containing but a small proportion. The odour will always convey a sufficient warning against its poisonous effects. It should be known that this gas will penetrate into dwellings in a very insidious manner. In Mr. Teale's cases, the pipe from which the gas had escaped, was situated about ten feet from the wall of the bed-room where the females slept. The gas had permeated through loose earth and rubbish, and entered the apartment through the floor. It is impossible to determine exactly what proportion of this gas in air will destroy life. An atmosphere containing from seven to twelve per cent. has been found to kill rabbits and dogs in a few minutes,—when the proportion was from one and a half to two per cent. it had little or no effect. With respect to man, it may destroy life if long respired when forming about nine per cent., i. e. when it is in less than an explosive proportion. (See B. and F. Med. Rev., xxix. 253; also, Ann. D'Hyg. 1830, i. 457.)

Chemical analysis.—The circumstances under which the accident occurs will generally suffice to establish the nature of the gas. 1. Coal-gas burns with a bright white light, producing carbonic acid and water. A taper should be cautiously applied to a small quantity; since when the gas is mixed with air in the proportion of eleven to fourteen per cent. it is dangerously explosive. For this reason no lighted candle should be taken into an apartment where an accident has occurred, until all the doors and windows have been for some time kept open. The combustion of the gas, or its explosion with air, is a sufficient test of its nature;—the peculiar odour and the want of action on a salt of lead, will distinguish it from sulphuretted hydrogen.

Exhalations of the dead.—It may not be inappropriate to make a few remarks in this place, on the supposed danger of the exhalations given off by dead bodies in a state of putrefactive decomposition; although this is a subject which more closely appertains to Medical Police. Formerly there existed a groundless fear relative to the examination of a putrefied dead body; and during the last century, on several important occasions, medical witnesses refused to examine the bodies of deceased persons, who were presumed to have been murdered, alleging that it was an occupation which might be attended with serious consequences to themselves. Orfila has collected many accounts of the fatal effects which are recorded to have followed the removal of the dead some time after interment. (Traité des Exhumations, vol. i. p. 2, et seq.) He allows, however, that the details of most of these cases are exaggerated, and attributes the effects which followed to other causes. Indeed the observations of Thouret and Fourcroy prove that these dangers are restricted within a very narrow compass, and that in general with common precautions the dead may be disinterred and transported from one locality to another, without any risk to those engaged in carrying on the exhumations. About the latter part of the last century, from fifteen to twenty thousand bodies, in almost

every stage of decomposition, were removed from the Cimetière des Innocens in Paris, and the accidents that occurred during the operations, which lasted ten months, were, comparatively speaking, few. The workmen acknowledged to Fourcroy, that it was only in removing the recently interred corpses and those which were not far advanced in decomposition, that they incurred any danger. In these cases, the abdomen appeared to be much distended with gaseous matter,—if ruptured, the rupture commonly took place about the navel, and there issued a sanious fetid liquid, accompanied by the evolution of a mephitic vapour, probably a mixture of carbonic acid and sulphuretted hydrogen. Those who respired this vapour at the moment of its extrication fell instantly into a state of asphyxia and died; while others, who were at a distance, and who consequently respired it in a diluted state, were affected with nausea, vertigo, or syncope, lasting for some hours, and followed by weakness and trembling of the limbs. Several lives have been lost of late years from the crowded state of the burial-grounds of London. A deep grave is dug, and this is kept open to be piled with coffins until filled. Persons venturing into these graves are immediately suffocated. The earth in these localities is strongly impregnated with poisonous exhalations; and no excavation can be made without its becoming immediately converted into a well of carbonic acid! (See Henke's Zeitschrift, 1840, ii. 446. Ann. D'Hyg. 1832, 216; 1840, 131; 1843, 28. 32.)

Smothering.—This is only a variety of suffocation, and consists in the mere covering of the mouth and nostrils in any way so as to prevent the free ingress and egress of air. Like drowning, hanging, or strangulation, it produces death by asphyxia. In newly-born infants, it is not an unusual occurrence, sometimes originating in accident and at others in criminal design. A young infant is very speedily destroyed in this way. If the mouth be only lightly covered over with clothing, or slightly compressed, so that respiration is interrupted, as in the act of carrying a child in the arms—this will suffice to cause death, and it is worthy of remark that death often takes place without being preceded by convulsions or other striking symptoms. Smothering is not often resorted to as a means of perpetrating murder, except in infants or in the debilitated and infirm. Certain trials which took place some years since, clearly proved that individuals, in a state of intoxication or infirmity, had been murdered by smothering, for the sake of the money derived from the disposal of the dead bodies! It will be sufficient to mention the trials of Burke and Macdougall in Edinburgh, and of Bishop and Williams in this metropolis, as affording ample evidence of the past existence of this horrible system of secret murder. (See Ed. Med. and Surg. Jour. April 1824, p. 236.) The victims were commonly destroyed by the murderer resting with his whole weight upon the thorax, so as to prevent the motion of the ribs, and at the same time forcibly compressing the mouth and nostrils by his hands, to prevent the ingress of air. In Nov. 1844, a man was

convicted at the Assizes of the Seine of the murder of a woman by placing a pitch-plaster over her face. A trial for murder by smothering took place at the Lincoln Lent Assizes, 1843. (The *Queen* v. *Johnson*.) The prisoner while committing a burglary tied the arms and legs of the deceased to a bed, so that she could not move, and then closely tucked the clothes over her head. After remaining some hours in this condition, the deceased died. The prisoner was convicted and executed. For an important case, involving the question of death from homicidal smothering or from apoplexy, see the *Queen* v. *Heywood*, Lancaster Aut. Ass. 1839. As an accident, smothering may be conceived to take place when an individual falls in a state of intoxication and debility, so that his mouth becomes in any way covered, or the access of air to the external outlets interrupted. On an inspection of the body, the appearances, described under the head of asphyxia, will be met with in the organs of circulation and respiration : hence in a suspected case of murder, we must look for the common indications of all the forms of death by asphyxia, and to the circumstances under which the body is found, before we can offer an opinion on the probable cause. (For some facts connected with this subject, see Ann. D'Hyg, 1837, ii. 485.)

LIGHTNING. COLD. STARVATION.

CHAPTER LVII.

Lightning.—Death by lightning is sufficiently common to require that a medical jurist should be prepared to understand the phenomena which accompany it; but there is a more important reason why he should devote some attention to this subject,—this is, that the appearances left by the electric fluid on the human body, sometimes closely resemble those produced by extreme mechanical violence. Thus a person may be found dead in an open field or on the highway, —his body may present the marks of contusion, laceration, or fracture; and to one unacquainted with the fact that such violence occasionally results from the passage of this subtle and invisible agent through the animal system, it might appear that the deceased had been murdered. The greater number of deaths from this cause, take place during the spring and summer. According to the annual report of 1838, there were 24 deaths from lightning registered during that year, occurring in the following seasons :—summer, 11; spring, 10; autumn, 2; winter, 1.

The electric fluid appears to act by producing a violent shock to the brain and nervous system. In a case which did not prove fatal, the patient who was seen soon after the accident, was found labouring under the following symptoms. Insensibility; deep, slow and interrupted respiration; entire relaxation of the muscular system; the pulse soft and slow; the pupils dilated, but sensible to light. (Med. Gaz. xiv., 654.) It will be seen that these are the symptoms of concussion of the brain. The effect of a slight shock is that of producing stunning; and when individuals who have been severely struck, recover, they suffer from tinnitus aurium, paralysis, and other symptoms of nervous disorder. Insanity has even been known to follow a stroke of lightning. (Conolly's Report of Hanwell, 1839.) Reaction is best brought about in cases of light shocks by cold affusion, and it may be observed of the effects of lightning generally, that death is either immediate or the individual recovers. A person may, however, linger and die from the effects of severe burns indirectly produced. A case occurred in this city, in July 1838, where death was thus caused indirectly by the effects of electricity. The following is an interesting case of the action of the electric fluid:—Three persons were at the same time struck by lightning. In one, a healthy man, aged 26, the symptoms were very severe. An hour and a half after the stroke, he lay completely unconscious, as if in a fit of apoplexy;—his pulse was below 60, full and hard, his respiration snoring, his pupils dilated and insensible. There were frequent twitchings of the arms and hands; the thumbs were flexed and immoveable, and the jaws firmly clenched. Severe spasms then came on, so that four men could scarcely hold the patient in his bed; and his body was drawn to the left side. When these had relaxed he was copiously bled, cold was applied to the head, a blister to the nape of the neck, and mustard poultices to the legs. Stimulating enemata and opium were also administered,—in the course of twenty-four hours consciousness slowly returned, and the man soon completely recovered. The only external injury discoverable was a red streak as broad as a finger, which extended from the left temple over the neck and chest; this disappeared completely in a few days. (B. and F. Med. Rev., Oct. 1842.)

Post-mortem appearances.—Generally speaking, the body, externally, presents marks of contusion and laceration about the spot where the electric current entered or passed out;—sometimes a severe lacerated wound has existed:—on other occasions there has been no wound or laceration, but a very extensive ecchymosis, which, according to Mayer, is most commonly found on the skin of the back. In one instance which occurred in London in May 1839, there were no external marks of violence whatever. I have not met with the account of any case where the appearance of a burn has been produced by the direct action of a stroke of lightning; for in those instances in which the marks of burns have been found upon the body, it appears

that ignition of the clothes or articles of furniture, had taken place, to which alone the burning was to be ascribed. The clothes are in almost all cases rent or torn and partially singed, giving rise to a peculiar odour—sometimes even rolled up in shreds and carried to a distance. Metallic substances about the person present traces of fusion, and articles of steel have been observed to acquire magnetic polarity. Actual ignition of the clothes is far from being a usual attendant on the passage of a current of electricity through the human body. Wounds are sometimes met with on the body. These have commonly been lacerated punctures, like a stab produced by a blunt dagger. In the recent case of an individual who was struck but not killed, a deep wound was produced in one thigh, almost laying bare the femoral artery. This individual was struck, as many others have been, while in the act of opening an umbrella during a storm. Fractures of the bones have not been commonly observed; in a case mentioned by Pouillet, the skull was severely fractured, and the bones depressed. (Traitê de Physique Elect. Atmosph.)

Rare as the combination of circumstances must be, in which a medico-legal question can arise in reference to the action of the electric fluid on the body, a case has been tried in France, (October 1845,) in which medical evidence respecting the characters of wounds caused by electricity, was of considerable importance. In August last some buildings were destroyed at Malaunay near Rouen, as it was alleged on the one side by a thunder-storm,—on the other by a whirlwind; and as the parties were insured against lightning, they brought an action for recovering the amount insured. The evidence in favour of the accident having been due to electricity, consisted, 1st, of the alleged carbonized appearance of the leaves of some trees and shrubs growing near, and, 2nd, the characters of the wounds on the bodies of several persons who were injured at the time of the occurrence. M. Lesauvage stated at the trial that there was an appearance of dark stains scattered over the bodies, and that those who survived, suffered from torpor, pains in the limbs and partial paralysis of motion. He observed also that decomposition took place very speedily in the dead. In one instance, the muscles were torn and lacerated and some small arteries divided. This witness attributed most of the wounds to a current of electricity. M. Funel deposed that in some of the dead bodies which he examined, the face and neck were bloated and discoloured, as if death had taken place from asphyxia. It does not appear, however, that there were any circumstances, decisively proving that the buildings had been destroyed by lightning. M. Pouillet has given an accurate description of the storm; and believes that, although, as deposed to by some of the witnesses at the trial, it may have been attended with thunder and lightning, the buildings with the surrounding trees were overthrown by the mere force of the wind. The description given bears out this view, but at the same time it is, I believe, a very rare circumstance that trees, unless old or dry and withered, bear any marks of combustion about the leaves or trunk; and the wounds on a person, are not likely to present the characters of burns, unless there are at the same time obvious marks of burning about the clothes. (See Comptes Rendus, Sept. 1845, also Med. Gaz. xxxvi. 1133.)

The blood is said not to become coagulated in the bodies of those who have been killed by lightning, while the muscles of such subjects are described as being constantly in a state of perfect relaxation, and never displaying any appearance of cadaverous rigidity. These statements have not been confirmed by observation. Ex-

periments carefully performed, have shown that blood through which electric discharges have been transmitted, will coagulate as quickly as that which has not been electrified; and further, Sir C. Scudamore discovered that, on examining the bodies of animals killed by the discharge of a powerful galvanic battery, the blood in the veins was always in a solid state. There is obviously, therefore, nothing in the action of the electric fluid to retard or prevent the coagulation of the blood. With respect to the alleged absence of cadaverous rigidity, there are many circumstances which may accelerate or retard the accession of this state in the dead muscle,—it may take place and disappear quickly, and the subject may not be seen at that particular time by the medical examiner. Sir B. Brodie has remarked that the body of an animal killed by electricity became, as usual, rigid after death. Putrefaction is also said to be hastened in these subjects; but putrefaction is modified by many varying circumstances, and death by lightning usually takes place during summer when the process is most readily developed. It does not appear that the process takes place more speedily, than in sudden or violent death from any other cause. Very few reports have been published of the appearances met with in the body, in cases of death from lightning. The body of a person who has died under these circumstances, is seldom examined for a coroner's inquest,—the cause of death being sufficiently obvious without a post-mortem examination.

The following appearances were found in the body of *Professor Richman,* who was killed at St. Petersburgh in 1753, while engaged in some experiments on atmospheric electricity. On the left side of the forehead, where the deceased had been struck by the electric current, there was a round ecchymosed spot. There were eight other patches of ecchymosis, of variable size, extending from the neck to the hip principally on the left side. Some of these situated on the trunk, resembled the marks produced by gunpowder, when discharged in contact with the skin. The left shoe was torn open at the buckle without being singed or burnt: but the skin around was slightly ecchymosed. Internally a quantity of blood was found extravasated in the trachea, the lungs and the layers of the omentum. The omentum presented the appearance of having been violently contused. (Marbach's Enkyklopädie, Blitz.) For a further account of the effects of the electric fluid on the human subject, see Henke Zeitschrift, der S. A. 1844, i. 193; also the Northern Journal of Medicine, Feb. 1845.

Cold.—The protracted exposure of the human body to a very low temperature may become a cause of death; and although in this country, cases but rarely occur in which cold alone operates fatally, it is not unusual during a severe winter, to hear of persons being found dead in exposed situations and in a state of misery and destitution. On these occasions, we may reasonably suspect that the want of proper food and nourishment has accelerated death. It is, however, convenient to make a distinction between the effects of cold and of inani-

tion on the system, as the symptoms preceding death and the rapidity with which that event takes place, are very different in the two cases.

Symptoms.—A moderate degree of cold is well known to have an invigorating effect upon the body, but if the cold be severe and the exposure to it long continued, while the calorific function is not maintained by warmth of clothing or exercise, the skin becomes pale and the muscles become gradually stiff and contract with difficulty, especially those of the face and extremities. Sensibility speedily disappears,—a state of torpor ensues, followed by profound sleep from which the person cannot be readily roused: in this state of lethargy, the vital functions gradually cease and the individual finally perishes. Such are the general effects of intense cold on the body. The effect of cold on the nervous system is seen in the numbness, torpor and somnolency which have been described as consequences of a long exposure to a very low temperature. Giddiness, dimness of sight, tetanus and paralysis, in some cases precede the fatal insensibility which involuntarily steals on the individual. It was observed during the retreat of the French from before Moscow, that those who were affected by cold often reeled about as if in a state of intoxication,—they also complained of vertigo and indistinctness of vision, and sank under a feeling of lassitude into a state of lethargic stupor, from which it was found impossible to rouse them. Sometimes the nervous system was at once affected;—tetanic convulsions, followed by rigidity of the whole of the voluntary muscles, seized the individual, and he rapidly fell a victim. Symptoms indicative of a disturbance of the functions of the brain and nervous system, have also been experienced by Arctic travellers during their residence within the Polar circle.

There are certain conditions which may accelerate death from cold. In all cases where there is exhaustion of the nervous system, as in the aged and infirm,—in those who are worn out by disease or fatigue,—or, lastly, in those addicted to the use of intoxicating liquors, the fatal effects of cold are much more rapidly manifested than in others who are healthy and temperate. It has been uniformly remarked that whenever the nervous energy is impaired either by intoxication or exhaustion from fatigue, the subject falls an easy victim to cold. The exposure of persons in a state of intoxication during a severe winter, may therefore suffice to destroy life; although the cold might not be so intense as to affect others who were temperate. Casualties of this nature sometimes occur during the winter season in this metropolis; and a knowledge of the influence of intoxication in accelerating death under such circumstances, may occasionally serve to remove any doubt in the mind of a practitioner respecting the real cause. Young infants especially when newly born easily perish from exposure to cold. (Ante, p. 481.) Cold, when accompanied by rain and sleet, appears to have a more powerfully depressing influence than when the air is dry—probably from the effects of evaporation. The following case by Dr. Currie, shows the fatal effects of cold winds accompanied by humidity.

"Of several individuals who clung to a wreck, two sat on the only part that was not submerged; of the others, all were constantly immersed in the sea, and most of them up to the shoulders. Three only perished, two of whom were generally out of the sea, but frequently overwhelmed by the surge, and at other times exposed to heavy showers of sleet and snow and to a high and piercing wind. Of these two, one died after four hours' exposure,—the second died three hours later, although a strong healthy adult and inured to cold and hardship. The third that perished was a weakly man. The remaining eleven who had been more or less completely submerged, were taken from the wreck next day after twenty-three hours' exposure,—and recovered. The person among the whole who seemed to have suffered least was a negro: of the other survivors, several were by no means strong men, and most of them had been inured to the warm climate of Carolina."

POST-MORTEM APPEARANCES.—Opportunities rarely occur of examining bodies, when death results purely from exposure to cold. The surface is commonly pallid and the viscera of the chest and abdomen, as well as the brain, are congested with blood. Dr. Kellie, of Leith, found in two cases which he examined, a redness of the small intestines from turgescence of the capillary vessels, and a great effusion into the ventricles of the brain. A sufficient number of cases have not yet been inspected to enable us to determine how far these two last-mentioned appearances are to be regarded as consequences of death from cold: but all observers have found a general congestion of the vascular system internally. In consequence of the great turgescence uniformly met with in the vessels and sinuses of the brain, some pathologists have regarded death from cold as resulting from an attack of apoplexy; but the symptoms which precede death do not bear out this view. Extravasations of blood have not been met with, and a mere fulness of the cerebral vessels after death, is not in itself sufficient to justify this opinion. It will be observed that on the whole these appearances are remarkably similar to those which are met with in death from severe burns and scalds. (See ante, p. 419.) Thus then the medical jurist will perceive that to come to a decision whether on the discovery of a dead body, death has taken place from cold or not, is a task of great difficulty. The season of the year,—the place and circumstances under which the deceased is found,—together with the absence of all other possible causes of death, such as from violent injuries or internal disease, form the only basis for a medical opinion. Death from cold is not to be determined except by negative or presumptive evidence, for there is no organic change either externally or internally, sufficiently characteristic of it, to enable us to decide positively on the subject. The following is a singular medico-legal case, involving the question of the fatal effects of cold upon the body. A man and his wife residing at Lyons, were tried for the murder of their daughter, a girl aged eleven, under the following circumstances. On

the 28th December, at a time when there was a severe degree of cold, the female prisoner compelled the deceased to get out of her bed, and place herself in a vessel of ice-cold water. The child cried and endeavoured to escape from the bath; but she was by violence compelled to remain in the water. The deceased complained of exhaustion and dimness of sight: the prisoner then threw a pail of iced water upon her head, soon after which the child expired. Death was properly ascribed to the effects of this maltreatment, and the parties were convicted. (Ann. D'Hyg. 1831. 207.) This case presents a refinement of cruelty which is rarely met with in the annals of crime. Such a case could only be proved by circumstances: for there would be no post-mortem appearances internally or externally, to indicate the mode of death. We learn by this, that the death of young children may be caused by the external application of very cold liquids, coupled with exposure. It would also appear from this case, that the brain and nervous system become sympathetically affected through the skin: and not through the introduction of cold air to the lungs. Indeed it is well known that air of a temperature considerably below zero, may be respired without risk, provided the skin be kept warm.

Starvation.—Death from the mere privation of food is an extremely rare event, although if we were to form an opinion from the verdicts of juries, its occurrence would not appear to be very uncommon in this and other large and populous cities. In the registration-returns for 1838-9 it is stated that 130 persons died from starvation. Such cases must, however, be received with some distrust, as care is rarely taken to ascertain precisely how far bodily disease may have been concerned in the death of the party. Still it cannot be denied that starvation should be classed among the causes of violent death, being sometimes the result of criminal neglect or inattention in the treatment of children or of infirm and decrepid persons, and thus constituting homicide; or at other times, although very rarely, arising from an obstinate determination to commit suicide in those from whom all other means of self-destruction are cut off.

The symptoms which attend on protracted abstinence are thus described by Rostan. In the first instance, pain is felt in the epigastrium, which is relieved by pressure. The countenance becomes pale and cadaverous,—the eyes become wild and glistening,—the breath hot,—the mouth dry and parched. A most intolerable thirst supervenes, which, in all cases of attempted suicide by starvation, has formed the most prominent symptom. The body becomes emaciated, the eyes and cheeks sink, and the prominences of the bones are perceptible: the feelings of pain are often so intense as to give rise to fits of delirium. There is the most complete prostration of strength, which renders the individual incapable of the least exertion. After a longer or shorter period, the body exhales a fetid odour, the mucous membrane of the outlets becomes sometimes red and inflamed, and life is commonly terminated by a fit of maniacal delirium or the most horrible convulsions. The *period* which it requires for an individual

to perish from hunger is subject to variation. It will depend materially upon the fact—whether a person has it in his power or not, to take at intervals, a portion of liquid to relieve the overpowering thirst which is commonly experienced. The smallest portion of liquid thus taken occasionally, is found to be capable of prolonging life. It is probable that in a healthy subject under perfect abstinence, death would not commonly take place in a shorter period than a week or ten days. This opinion appears to derive support from the results of those cases, in which there has been abstinence owing to disease about the organs of deglutition.

POST-MORTEM APPEARANCES.—There are no very satisfactory details of the appearances presented by the bodies of those who have died of inanition: and the cases themselves are too rare to enable us to decide with certainty upon the accuracy of the reports which have hitherto appeared on the subject. The body has been found much emaciated,—the skin dry,—and the stomach and intestines contracted and empty, the mucous membrane sometimes ulcerated: the gall-bladder distended with bile,—the lungs, heart, and great vessels connected with these organs, collapsed and destitute of blood. A good account of the appearances met with in starvation, has been published by Dr. Sloan, of Ayr.

A healthy man, aged sixty-five, was by an accident shut up in a coal-mine twenty-three days. For the first ten days he was able to procure and swallow a small quantity of foul water. When found, he could not make the least exertion, nor could he speak above a whisper. Attempts were made to recover him, but he died in three days perfectly exhausted. On inspection, the body was observed to be extremely emaciated,—the intestines were collapsed, the stomach distended with air, and slightly reddened at its cardiac extremity. The liver was small and the gall-bladder distended. The other viscera were in their normal state. (Med. Gaz. xvii. 389.) Mr. Tomkins, of Yeovil, inspected the body of a man who died from starvation. in Feb. 1838. The face was much shrunk and emaciated, the eyes open and presenting a red fiery appearance, as intense as in a case of acute ophthalmia during life. The skin was tough and there was scarcely any cellular membrane to be seen. The tongue, lips, and fauces were dry and rough. A peculiar odour exhaled from the body. The lungs were shrunk and contracted—the pleura slightly inflamed. The stomach and intestines were empty but quite healthy—the gall-bladder was nearly full of bile, and the surrounding parts were much tinged by this liqud. The urinary bladder was empty and contracted. (Lancet, March 1838.)

These appearances, in order to throw any light upon the cause of death, should be accompanied by an otherwise healthy state of the body: since, as it is well known, they may be produced by many organic diseases, and death may be thus due to disease, and not to privation of food. It is not easy to say whether the emaciation depend on disease or a want of food, unless we are put in possession of the history of the case. On this account it is, that in all charges of homicidal starvation, the defence generally turns upon the co-existence of disease in the body, and the sufficiency of this to account for death. In many of these alleged deaths by starvation, ulceration of the

bowels is met with, which some have considered to arise from a want of food. (See the case of the *Queen* v. *Pryke*, Chelmsford Summer Ass. 1840.)

Starvation is commonly the result of *accident or homicide*, but this is a question purely for the decision of a jury,—it cannot be elucidated by medical evidence. The withholding of food from an infant, forms a case of homicide by starvation, on which a medical opinion may be occasionally required. Mr. Baron Gurney held that the *mother* and not the father was bound to supply sustenance to an infant. The child in this case was ten weeks old, and the father was charged with wilful murder, on the ground that he had not supplied it with food. The grand jury ignored the bill under the instructions of the judge, upon the ground above stated. (*The King* v. *Davey*, Exeter Lent Ass. 1835.) But where the husband and wife were charged with the murder of an apprentice to the husband, by using him in a barbarous manner, and the opinion of the medical witness was, that the boy had died from debility occasioned by the want of proper nourishment, it was held that the wife was entitled to be acquitted, as it was the duty of the *husband* and not of the wife to provide sufficient food and nourishment for the apprentice. (*The King* v. *Squire*, Starkie, ii. 947.) Starvation is rare as an act of homicide, but it must not be supposed that the law implies by this, the absolute privation of food; for if that which is furnished to a person be insufficient in quantity or of *improper quality*, and death be a consequence, malice being at the same time proved, then the offender equally subjects himself to a charge of murder. Not many years since, a woman who was accustomed to take parish-apprentices, was tried and convicted for the murder of two children, who died in consequence of the bad quality and small quantity of food, furnished to them by the prisoner.

INSANITY.

25/2/61

CHAPTER LVIII.

UNSOUNDNESS OF MIND. FORMS OF INSANITY.

THE law of England recognizes two states of mental disorder or alienation. 1. *Dementia naturalis*, corresponding to idiocy, and 2. *Dementia adventitia*, signifying general insanity, as it occurs in individuals who have once enjoyed reasoning power. To this state, the term lunacy is also applied from an influence formerly supposed to be exercised by the moon on the mind. *Lunacy* is a term generally applied by lawyers to all those disordered states of the mind which are known to medical men under the names of mania, monomania and dementia, and which are generally, though not necessarily, accompanied by lucid intervals. The main character of insanity, in a legal view, is said to be the existence of *delusion*, i. e. that a person should believe something to exist which does not exist, and that he should act upon this belief. Many persons may labour under harmless delusions, and still be fitted for their social duties; but should these delusions be such as to lead them to injure themselves or others in person or property, then the case is considered to require legal interference,—otherwise not.

Besides the terms *Idiocy* and *Lunacy*, we find another, frequently employed in legal proceedings, namely, "*unsound mind*"—(*non compos mentis*)—of the exact meaning of which it is impossible to give a consistent definition. From various legal decisions, it would appear that the test for unsoundness of mind in law, has no immediate reference to the mere existence of delusion, so much as to proof of incapacity in the person, from some morbid condition of intellect, to manage his affairs. (Amos.) Neither condition will suffice to establish unsoundness without the other; for the intellect may be in a morbid state, and yet there may be no legal incompetency, or the incompetency alone may exist and depend on bodily infirmity, or want of education, a condition which must not be confounded with insanity. Thus then a person may be of unsound mind, i. e. legally incompetent to the control of his property, and yet not come up to the strict legal standard of lunacy or idiocy. Hence it will be seen that it is impossible in medical jurisprudence, to give any consistent definition of insanity. A medical witness who ventures upon a definition, will generally find himself involved in numerous inconsistencies. No

words can possibly comprise the variable characters which this malady is liable to assume. Some medical practitioners have attempted to draw a distinction between insanity and unsoundness of mind. A case occurred in 1839, where a medical man hesitated to sign a certificate for the confinement of an alleged lunatic; because in it, the terms "unsound mind" were used. He said he would not have hesitated to sign it, had the term "insane" been substituted. The difference, if any exist, is purely arbitrary, and depends on the fact, that unsound mind is a legal and not a medical phrase, referring to an incapacity to manage affairs, which insanity in its most enlarged sense, may not always imply. The law, however, appears to admit some sort of distinction; for, according to Chitty, it is a criminal and an indictable act maliciously to publish that any person is afflicted with insanity, since it imputes to the party a malady generally inducing mankind to shun his society; although it is not libellous to say that a man is not of sound mind, because no one is of perfectly sound mind but the Deity! (M. J. i. 351.) In reference to the refusal to sign certificates, it is, however, an error to suppose that the use of one term can involve a practitioner in a greater share of responsibility than the use of the other.

Medical jurists have commonly treated insanity under four distinct forms: *Mania, Monomania, Dementia, and Idiocy.* This division was proposed by Esquirol; and although of a purely artificial nature, it is highly convenient for the arrangement and classification of the facts connected with the subject. In some instances, there is great difficulty in assigning a particular case to either of these divisions, which is owing to the circumstance that these states of mind are frequently intermixed, and are apt to pass and repass into each other. On other occasions, a case may present characters which appertain to all the divisions. Some psychologists have proposed two subdivisions;—namely, Incoherency and Imbecility, but the former is merely a mixed state of mania and dementia, while the latter is a term applied to those cases of idiocy, wherein the mental faculties are more or less susceptible of cultivation after birth, without reaching the normal standard. In a Manual of Medical Jurisprudence it will be only necessary to state briefly the principal features of each of these varieties of insanity. For a more full account of them, I must refer the reader to the well known treatises of Esquirol, Marc and Prichard.

Mania.—In this form of insanity, there is a general derangement of the mental faculties, accompanied by greater or less excitement, sometimes amounting to violent fury. The individual is subject to hallucinations and illusions, the difference in the meaning of which terms, it may be here proper to explain. *Hallucinations* are those sensations which are supposed by the patient to be produced by external impressions; although no material objects act upon the senses at the time. *Illusions* are sensations produced by the false perception of objects. (Marc.) When a man fancies he hears voices, while there is profound

silence, he labours under a hallucination: when another imagines that his ordinary food has an earthy or metallic taste, this is an illusion. Illusions sometimes arise from internal sensations, and give rise to the most singular ideas. When a hallucination or illusion is believed to have a real and positive existence, and this belief is not removed either by reflection or an appeal to the other senses, the individual is said to labour under a *delusion*: but when the false sensation is immediately detected, and is not acted on as if it were real, then the person is sane. Perhaps this is the most striking distinction which it is in our power to draw between sanity and insanity. The acts of the insane are generally connected with their delusions; but it is extremely difficult to trace the connection between them except by their own confession. It has been remarked that in mania there is great insensibility to changes of temperature; but it must not be inferred from this, that the patient is less susceptible than a sane person of the injurious effects of cold. The bodily susceptibility of insane persons is just as great, while they want that warning power, which the sense of feeling gives to one who is sane. It is necessary that a medical jurist should be able to distinguish *mania* from delirium depending on bodily disease. *Delirium* very closely resembles the acute form of mania, so closely that mistakes have occurred, and persons labouring under it, have been ordered into confinement as maniacs. The following are perhaps the best diagnostic differences. A disordered state of the mind is the first symptom remarked in mania, while delirium is a result of bodily disease,—there is also greater febrile excitement than in mania. Delirium being a mere symptom attendant on the disease which produces it, exists so long as that disease, and no longer; while mania, depending on very different causes, is persistent. Delirium disappears suddenly, leaving the mind clear; while mania commonly experiences only remissions. (See Pagan, Med. J. of Ins. 69.)

Monomania.—This name is applied to that form of insanity in which the mental alienation is partial. The delusion is said to be confined to one subject or to one class of subjects. One fact is well ascertained, that it varies much in degree:—for many persons affected with monomania, are able to direct their minds with reason and propriety to the performance of their social duties, so long as these do not involve any of the subjects of their delusions. Further, they have occasionally an extraordinary power of controlling their thoughts and emotions, and concealing the delusions under which they labour. This implies a consciousness of their condition, not met with in mania; and it also appears to imply such a power of self-control over their thoughts and actions, as to render them equally responsible with a sane person for many of their acts. In a real case of monomania, it is not to be supposed that a man is insane upon *one* point only, and sane upon all other matters. The only admissible view of this disorder, is that which was taken by Lord Lyndhurst, in one of his judgments. In monomania, the mind is unsound; not unsound in

one point only, and sound in all other respects, but this unsoundness manifests itself principally with reference to some particular object or person. (Prichard.) There is no doubt that all the mental faculties are more or less affected; but the affection is more strikingly manifested in some, than in others. Monomania is very liable to be confounded with eccentricity: but there is this difference between them. In monomania, there is obviously a change of character, the individual is different to what he was: in eccentricity, such a difference is not remarked:—he is, and always has been, singular in his ideas and actions. An eccentric man may be convinced, that what he is doing, is absurd and contrary to the general rules of society, but he professes to set these at defiance. A true monomaniac cannot be convinced of his error, and he thinks that his acts are consistent with reason and the general conduct of mankind. Eccentric habits suddenly acquired are, however, presumptive of insanity. It will be seen hereafter that the diagnosis is of some importance in relation to the testamentary capacity of individuals.

Most medico-legal writers admit that insanity is not necessarily confined to the intellectual powers; but that it may also show itself without decided intellectual aberration in the feelings, passions and emotions. Thus it may appear under the form of a causeless suspicion, jealousy, or hatred of others, especially of those, to whom the individual ought to be attached; and it may also manifest itself under the form of a wild, reckless and cruel disposition. This is what has been called by Dr. Prichard, "*Moral insanity*," to distinguish it from the other form affecting the mental powers, namely, "*Intellectual insanity*." It is, however, very doubtful whether moral insanity ever exists in any individual without greater or less disturbance of the intellectual faculties. The mental powers are rarely disordered without the moral feelings partaking of the disorder: and conversely it is not to be expected that the moral feelings should become to any extent perverted without affecting the intellect. The intellectual disturbance may be very difficult of detection; but in every case of true insanity, it is more or lest present, and it would probably be a dangerous rule to pronounce a man insane, where some evidence of its existence was not forthcoming. The law hesitates at present to recognize moral insanity, at least in civil cases: hence, however perverted the affections may be, a medical jurist must look for some indications of intellectual disturbance. Monomania may be accompanied with a propensity to homicide or suicide; and according to many psychologists, with a disposition to incendiarism or theft. These forms will be referred to hereafter, in speaking of the criminal responsibility of the insane.

Dementia.—In this state there is a total absence of all reasoning power;—the mental faculties are not perverted, but destroyed. There is a want of memory as well as a want of consciousness on the part of the individual, of what he does or says. It is by no means an unfre-

quent consequence of mania or monomania,—but it has been known to occur suddenly in individuals, as an effect of a strong moral shock.

IDIOCY.—Idiocy is characterized by the want of mental power, being congenital. While mania, monomania, and dementia, form the "*dementia accidentalis*," idiocy forms the "*dementia naturalis*" of lawyers. This intellectual deficiency is marked by a peculiar physiognomy, an absence of all expression, and a vague and unmeaning look, whereby an idiot may in general be clearly identified. In some cases of congenital deficiency, the mind is capable of receiving a few ideas, and of profiting to a certain extent by instruction. To this state the term IMBECILITY is applied. It may be regarded as a minor degree of idiocy. The mind of an imbecile can never be brought to a healthy standard of intellect, like that of an ordinary person of the same age. The degree to which congenital deficiency of intellect exists, is generally well marked by the power of speech, or of communicating ideas by language. In idiocy there is no speech, or only an utterance of single words :—in the better class of imbeciles, the speech is but little affected: while there is every grade between these two extremes. Some medical jurists have arranged imbeciles in classes, according to their capacity to receive instruction ;—others according to their power of speech: but such divisions are practically without value,—each case must be judged of by itself. It is by no means easy to draw a distinction between the better classes of imbeciles and those who are reputed sane,—since the minds of sane persons, differ remarkably in their power to receive instruction. It has been well observed, that by endeavouring to make a very close distinction of this kind, one half of the world might reason itself into the right of confining the other half, as insane! Persons affected with idiocy and imbecility do not suffer from hallucinations and illusions, like those who labour under mania or monomania. Idiots and imbeciles are what they always have been: there is no gradual loss or impairment of the intellectual functions. The term imbecility is often applied to that loss of mental power, which takes place as a result of extreme age: but this is with greater propriety called *senile dementia*.

Such are the forms under which insanity or mental alienation presents itself to our notice. This classification has been adopted for the sake of convenience; because by it, a practitioner may be led to form a safe diagnosis of the real state of mind of a person. It is not recognized in any of the law-proceedings connected with the insane :—for here the term unsoundness of mind, comprehending lunacy and idiocy, is almost exclusively employed. In adopting this arrangement, a medical jurist must take care not to fall into an error which has been sometimes committed, i. e. of pronouncing a person to be of sound mind, because his case could not be easily placed in any one of these four great divisions of insanity. This would be as serious an error as

that formerly committed by some law-writers,—namely, of giving restricted and inappropriate definitions to lunacy and idiocy, and then contending that, whoever was not a lunatic or idiot according to these arbitrary legal definitions, must be a person of sound mind!

Hereditary transmission.—The *hereditary transmission* of the malady has sometimes presented itself as a medico-legal question in relation to the criminal responsibility of the insane. According to Chitty, it is an established rule of law, "that proof that other members of the same family have decidedly been insane, is not admissible either in civil or criminal cases." (Med. Jur. i. 352.) But recent decissions have shown that this statement is not correct. In the case *Reg.* v. *Ross Touchet,* 1844, tried and acquitted on the ground of insanity for shooting at a man, Maule, J., held that evidence that the grandfather had been insane may be adduced, after it has been proved by medical testimony that such a disease is often hereditary in a family. It was also admitted in *Oxford's* case,—the prisoner having been here tried for shooting at the Queen. (Law Times, Oct. 26, 1844.) This kind of evidence was, however, rejected in *Greensmith's* case, (post, p. 663,) and it is not admitted in the law of Scotland. (*Gibson's* case, Edinburgh, Dec. 1844.) There can be no doubt, from the concurrent testimony of all writers on insanity, that a pre-disposition to the disease is frequently transmitted from parent to child through many generations. The malady may not always show itself in such cases; because the offspring may pass through life without being exposed to any exciting cause: but in general it readily supervenes from very slight causes. M. Esquirol has remarked that this hereditary taint is the most common of all the causes to which insanity can be referred, more especially as it exists among the higher classes of society. Among the poor, about one sixth of all the cases may be traced to this hereditary taint; and other authorities have asserted that in more than one half of all cases of insanity, no other cause can be found for the malady. As we might suppose,—children which are born before insanity manifests itself in the parents, are less subject to the disorder than those born afterwards. When one parent only is insane, there is less tendency for the predisposition to be transmitted, than when both are affected; but according to Esquirol, this predisposition is much more readily transmitted through the female than through the male parent. Its transmission is also more strikingly remarked when it has been observed to exist in several generations of lineal ancestors; and like other hereditary maladies, it appears to be subject to atavism; i. e. it may disappear in one generation and re-appear in the next. Further, the children of drunken parents and of those who have been married late in life, are said to be more subject to insanity, than those born under other circumstances. When insanity is transmitted by hereditary descent, it appears often about the same age, under the same form, and is induced

by the same exciting cause in the offspring as in the parent. This it is proper for a medical jurist to bear in mind, in examining a plea of insanity in criminal cases. The valuable tables of Esquirol show that the age at which insanity most commonly attacks persons, is thirty:—it rarely makes its appearance below the age of twenty or above the age of fifty-five.

FEIGNED INSANITY.—Insanity is frequently feigned by persons accused of criminal offences, in order to procure an acquittal or discharge. In the first place, when this is suspected, it will be proper to inquire, whether the party has any *motive* for feigning the malady. It is necessary to remember that insanity is never assumed until *after* the commission of a crime and the actual detection of the criminal. No one feigns insanity merely to avoid suspicion. In general, as in most cases of imposture, the part is overacted—the person does too much or too little, and betrays himself by inconsistencies of conduct and language, which are never met with in real cases of insanity. There is commonly some probable cause to which real insanity may be traced, but when the malady is feigned, there is no apparent cause:—in this case also, the appearance of the assumed insanity is always sudden:—in the real malady, the progress of the attack is generally gradual, and when the attack is really sudden, then it will be found to be due to some great moral shock or other very obvious cause. We should observe whether there has been any marked change of character in the individual, or whether his conduct, when he had no interest to feign, was such as it is now observed to be. Some difficulty may arise when fits of eccentricity or strangeness of character, are deposed to by witnesses; but these statements may be inconsistent with each other, and the previous acts of the person may bear no resemblance whatever, to those performed by him in the recently assumed condition. A difficulty of this kind rarely presents itself, since in an impostor, no act indicative of insanity can be adduced for any antecedent period of his life: it is only *after* the perpetration of a crime, and its detection, that any acts approaching to insane habits, will be met with. In real insanity, the person will not admit that he is insane:—in the feigned state all his attempts are directed to make you believe that he is mad:—if told that he is insane, he does not contradict you; and an impostor may be induced to perform any act, if it be casually observed to another in his presence, that the performance of such an act will furnish still stronger evidence of his insanity.

Mania is perhaps more frequently assumed than any other form, because the vulgar notion of insanity is, that it is made up of violent action and vociferous and incoherent language: but mania rarely comes on suddenly, or without an obvious cause:—the patient is also equally furious night and day, while the impostor is obliged to rest after his violent exertions. Dr. Burrows recommends that close attention should be paid to the expression of the eye. The mobility of

the features may be as rapid as the imagination is vivid : but when every feature may vary, or be kept under control and be steady, the eye will still indicate the erring thought. Its expression cannot be easily assumed. In mania the person sleeps but little, and the sleep is disturbed :—an impostor sleeps as soundly as a healthy individual :—the violence of the maniac continues whether he is alone or not, while the impostor acts his part only when he thinks he is observed : hence the imposition may be detected by watching him, when he is not aware that an eye is directed upon him.

Some stress has been laid on the fact that assumed insanity commonly appears suddenly and without probable cause ; but while this may be allowed to have a general value in forming a diagnosis, it is proper to bear in mind that the actual commission of a crime has sometimes suddenly led to an attack of mania in a previously sane person. Dr. Pagan has related a very singular instance of this kind. Two men were committed to prison on a charge of theft, and the officers requested a poor man, who was a shoemaker, to assist them in conveying the prisoners. The man took a gun with him for better security. During the journey, one of the prisoners leaped from the cart and ran off. The officers called to their assistant to fire, and he thinking himself warranted to do so, fired, and wounded the prisoner severely in the back and loins. The man who fired the gun was himself immediately committed to gaol as a criminal, and the event made such an impression upon him, that he became violently maniacal. When scarcely recovered he was tried for the offence ; and it was supposed that he was feigning insanity. He was convicted and sentenced to six months imprisonment. (Med. Jur. of Ins. 82.) This case proves that a person may really be attacked by mania under circumstances, in which a justifiable suspicion might arise that he was feigning.

The feigning of monomania would be a matter of some difficulty, and easily susceptible of detection. Dementia is more easily feigned : —in general this state comes on slowly, and is obviously dependent on organic changes, as old age, apoplexy, paralysis or hemiplegia, or it is a consequence of long-continued mania or monomania. As this form of insanity consists in an entire abolition of all mental power, so the discovery of any connected ideas, reasoning or reflection either by language or gestures, would at once show that the case was not one of real dementia. Idiocy and imbecility could hardly be feigned successfully, because these are states of congenital deficiency ; and it would be easy to show, by reference to the past life of a person, whether or not he had always been such as he represents himself. The difficult cases of feigned insanity are really limited to those forms of the malady which are liable to attack an individual suddenly. In a sudden attack of real insanity, there should be some obvious cause : —the non-existence of this with the presence of a strong motive for deception, will always justify a suspicion that the malady has been assumed.

The following is a case of feigned insanity which was the subject of a trial in London, in 1833. A married woman, aged fifty, was charged with uttering a forged cheque:—she had craftily procured the signature of a person under a false pretence, and then forged his name to the cheque. When required to plead she made no answer, and appeared unconscious of the question. She took up some flowers placed in the dock, and crumbled them in her fingers, which were in continual motion. She stared wildly at times, changing her position,—turned her back on the court,—muttered indistinct exclamations and made a humming noise. She was placed under some restraint in order to prevent her jumping out of the dock. The first question which the jury were directed to try, was whether she were of "sound mind or not,"—it being a rule of law, that no insane person can be called on to plead to an offence committed by him. Evidence was then adduced to show, that at previous periods of her life she had used incoherent language, and was strange in her conduct. It was also shown that her mother, aunt, and sister, had been insane. Dr. Uwins deposed that at first he thought the prisoner was feigning; for she appeared to be fully aware of the importance of a plea of insanity, but when he heard that other members of her family had had the disease, he was induced to think her insane, and not accountable for her actions. Another medical witness, who had attended her family professionally, and had known the prisoner long, thought she was not insane, although he allowed that the apprehension of a criminal charge might bring on an attack of insanity in a mind subject to aberration. Other witnesses deposed that they had never observed any acts of insanity about her; and it was further proved that she was well acquainted with the method of drawing and procuring money on bills. When arrested, she tried to escape from the officer and conceal the money which she had procured by means of the forged cheque. The surgeon of the gaol thought she was feigning: he visited her daily, and he observed that her manner was changed so soon as she saw him. When asked what counsel she would employ, she returned a rational answer, saying that "others would take care of that:" when charged with feigning she made no observation. She put on a wild look when she knew she was observed; but when privately watched, her behaviour was that of a rational person:—she generally slept soundly. The jury returned that she was of sound mind. She was then called on to plead to the charge, but she refused,—a circumstance rarely observed in the conduct of a really insane person. She was tried and found guilty of the charge. There could be no reasonable doubt that this woman was an impostress, and that she feigned insanity, well knowing what would be the result of the plea, if admitted. Two circumstances rather tended to complicate the case: 1. the proof of hereditary predisposition: 2. her assumed silence, whereby she did not easily betray herself. In regard to hereditary predisposition, although valuable as collateral evidence, it cannot, of course, be allowed to outweigh general facts indicative of perfect sanity. For a singular case in which a verdict was returned against strong medical evidence of alleged insanity, see Lancet, January 18, 1845, p. 70: also Ann. D'Hyg. 1829, ii. 367, 376.

CHAPTER LIX.

RESTRAINT. INTERDICTION. LUCID INTERVALS.

Among the questions which may come before a medical jurist, in relation to the subject of insanity, are the following: A practitioner

may be required to say whether or not a person affected with the malady should be confined in a lunatic asylum,—whether he should be deprived of his civil rights by interdiction, or whether he be so completely cured of his malady, as to justify his liberation from confinement. Then, again, medical evidence may go far to determine whether a will or deed, executed by an alleged lunatic, should be set aside; whether a marriage-contract should be annulled; and lastly, whether a criminal act was committed by a person labouring under insanity,—a question involving either the life or, according to circumstances, the perpetual imprisonment of an accused party.

RESTRAINT.—By this we are to understand the separation of the lunatic with or without the confinement of his person by force,—and the point to be considered is: What are the circumstances which will justify a practitioner in applying restraint to the insane? The law has given great power in this respect to members of the medical profession, but owing to certain abuses, this power has been of late years much restricted by various acts of the legislature. Most medico-legal writers agree, that we are never justified in ordering restraint, except when from the symptoms, we have reason to apprehend that the lunatic will injure his person or property, or the persons or property of others. It is then not sufficient to seek merely for evidence of delusion: but if we discover that the individual labours under some delusion, it is our business to consider how far that may endanger the well-being of himself and his friends. Unless the delusion be such as to render it probable that his own interests or those of others, may be damaged by his insane conduct, careful and judicious superintendence will answer all the purposes of the closest restraint. Some have justified the act of resorting to restraint on all occasions, on the principle that it may tend to the cure of a patient by removing the delusion. In this point of view, the subject has no relation to legal medicine. It may be urged with more plausibility, that by withholding restraint in incipient cases, mischief may be done by the lunatic to himself or others; and then it will be too late to interfere; but even here proper superintendence will render close confinement unnecessary. A medical practitioner must not be too ready to lend himself to the signing of certificates for the close imprisonment of persons, who may be labouring under harmless delusions. In violent mania, or in monomania with a homicidal or a suicidal propensity, there can be no doubt of the propriety of applying some degree of restraint, for here the necessity is imminent. If a remarkable change has taken place in the character of the patient; if he has become irritable, outrageous or threatened personal violence to any one, or if he has recklessly endangered the interests of himself and family, he is undoubtedly a fit subject for restraint. (See Pagan, 75.) The more he approaches to this condition, the less difficulty shall we have in coming to a decision, and in a really doubtful instance, there will be no impropriety in employing restraint; since although the person is thereby deprived of liberty, it is better that this

should happen, than that he or his friends should incur the risk of suffering severely by his insane conduct.

Violence of temper must not be taken as a proof of insanity. A man may have always had a violent temper, subject to occasional fits of aggravation:—this must not be confounded with mental disease. In order to determine whether the acts be due to violent temper or insanity, it will be proper to ascertain what may have been the natural habits of the party. The great feature of insanity is *change* of character: a man who is really insane is different to what he has previously been; but it may be proved of a violent-tempered man, that he has always been the same. The greatest abuses of the restraint-system have been chiefly observed in respect to monomania, where individuals have been forcibly imprisoned because they entertained some absurd delusions, over which, however, they had so great a power of control, as to render it somewhat difficult for a shrewd and experienced examiner to detect them. When, at last, after many hours' cross-examination, the existence of delusion has been made apparent, the result has been looked upon as furnishing matter for triumph and exultation; but as Dr. Conolly justly remarks, one point in these cases appears to have been wholly lost sight of, namely,—What possible injury could have resulted to the patient or his friends from the existence of a delusion, over which he had such complete control and mastery as to render it a most laborious task to obtain any evidence of its presence? (Indic. of Ins.) It may be freely admitted, that where such a delusion does exist, there is reason to suppose that the mind must be more or less disordered in all of its faculties; but such patients require close watching, not a rigorous imprisonment. The greatest danger is to be apprehended in all those cases, where there is the least power of self-control.

It will be here necessary to state the circumstances which require the attention of a practitioner when he is called upon to sign a certificate of insanity, whereby a person may be placed in confinement in an asylum. The act which specially refers to this subject is the 8th and 9th Victoria, c. 100th, ss. 45, 46, 47, 48, and 49. This act, which came into operation on the 4th August 1845, is a consolidation of all the statutes on the regulation of the care and treatment of lunatics. Its provisions are very stringent, both with respect to medical men signing certificates, and those who keep asylums for the reception of lunatics.

According to section 45, no person (not a pauper) can be received into or detained in any licensed house or hospital, without an order from some person, and two medical certificates which must be signed by *two physicians, surgeons or apothecaries* not in partnership, and each of whom shall *separately from the other*, have personally examined the person to whom it relates not *more than seven clear days previously* to the reception of such person into such house or hospital, and shall *have signed and dated the same on the day* on which such person shall have been so examined.

Form of medical certificate in the case of private patients s. 45.

I ————, being a physician *or* surgeon *or* apothecary duly authorized to practise as such, hereby certify, that I have this day examined A. B. the person named in the accompanying statement and order, and that the said A. B. is a lunatic [*or* an insane person, *or* an idiot, *or* a person of unsound

mind,] and a proper person to be confined, and that I have formed this opi nion from the following fact or facts: viz.

(Signed) Name.
Place of abode.

Dated this day of one thousand eight hundred and

Under the same section, any physician, surgeon or apothecary, who shall knowingly sign any such medical certificate as aforesaid, which shall untruly state any of the particulars required by this act, shall be guilty of a misdemeanour.

The 46th section orders for the first time, that every medical practitioner, signing such certificate, must specify *facts upon which his opinion is formed*, and whether these are derived *from his own observation* or from the information of any other person. The 47th section provides that in cases of emergency a person (not a pauper) may, under special circumstances (these being stated in the order) be received into a house or hospital upon a certificate signed by *one* medical practitioner only, provided that within *three days*, another such certificate shall be signed by some other medical practitioner, not being connected with such house or hospital, upon a like examination. The detaining of a person upon one medical certificate only, beyond the period of three days without such further certificate, is a misdemeanour in the keeper of the house or hospital.

By s 48th the certificate of *one* medical practitioner only, signed according to the above rules, will suffice for a *pauper lunatic*, provided the party has been previously examined by a justice, clergyman or overseer, and has received an order setting forth the particulars of the case.

By s. 49th no medical practitioner, who is interested in or attends a licensed house or hospital, or whose father, brother, son or partner is wholly or partly the proprietor of or a regular professional attendant in such house or hospital, shall sign any certificate for the reception of a patient into it, "and any physician, surgeon or apothecary, who shall sign any certificate contrary to any of the provisions herein contained, or without having complied with all the provisions hereby required in the case of the patient to whom the same shall relate, or who shall in such certificate, *describe his medical qualification untruly*, or shall untruly state any thing therein, shall be guilty of a misdemeanour."

As ignorance of the law is never allowed to be an excuse for its violation, so a medical man, unless acquainted with all the particulars above-mentioned, may easily subject himself to a prosecution; and he is not likely to be spared the disgrace and mortification attendant upon this, should it so happen that the case is of a doubtful nature. The law expressly requires from each medical man, a separate visit, a separate personal examination of the alleged lunatic, and a separate medical certificate, setting forth the special fact or facts, whether observed by himself or derived from the information of others, upon which his opinion is based.

One circumstance connected with the 45th section, requires comment. Would the two certificates for the reception of a person be valid, if signed by *one physician* and *one surgeon*, or one surgeon and one apothecary? The words of the act are *two* physicians, surgeons *or* apothecaries; and it does not provide for the separate signatures of individual members of the three grades of the profession, except under section 47, where a private patient is admitted from special circumstances, upon a certificate signed by one medical practitioner only!

Discharge of lunatics.—In forming an opinion relative to the propriety of discharging a person, who has once been confined as a lunatic

in an asylum, it is proper to examine the particulars of his case, with the same caution as if the object were to confine him for the first time. The question of liberation is commonly restricted, like that of restraint, to cases of mania and monomania. It may so happen, that an individual has a lucid interval at the time of examination, in which case, it will be necessary to make more than one visit. One who has been guilty of a heinous crime like murder, should never, on any pretence, be discharged. There are often long lucid intervals in homicidal mania; and it is impossible to be certain that the disease is entirely removed. If the individual has manifested the least disposition to suicide, we should be extremely cautious of liberating him; for suicidal mania is often artfully concealed under a cheerful exterior. We cannot always test the propriety of granting liberation by the lightness of the offence for which a criminal lunatic has been confined. The circumstances under which the most trifling offence has been committed, may show that the mind is wholly unsettled with regard to moral responsibility; and such lunatics can never be trusted, even when there is great improvement in their language and deportment. The unhappy result of prematurely discharging a criminal lunatic, was seen in the case of a man named *Thom,* otherwise styling himself Sir William Courtenay. He was shot while rioting with many others near Canterbury in June 1838. The whole life of this man seems to have been made up of a mixture of eccentricity and insanity. He was guilty of the most flagrant perjury, was tried, found insane and confined as a lunatic. After the lapse of about six months, it was thought that he was so much improved as to allow of his discharge; although even at this time, it appears that he fancied himself to be the Saviour! On his discharge, he was guilty of many extravagant acts; he collected a number of ignorant persons as his followers, and infected them with his delusion. He resisted the military who were sent to apprehend him, and eleven lives were lost on the occasion. A medical man cannot always be responsible for unfortunate consequences of this kind; but this and other similar instances show that great risk is incurred in hastily allowing the discharge of a lunatic, who has once been guilty of a crime, however slight, so palpably depending on a disordered mind. The 8th and 9th of Victoria, c. 100th has placed certain restrictions on the power of liberating lunatics. Under s. 72, the person, originally signing the order which is required in addition to the medical certificates, may write an order for his discharge or removal; but under s. 75 this order is of no effect, if a medical practitioner certify, that in his opinion such patient is dangerous and unfit to be at large, together with the grounds on which such opinion is founded, unless the Commissioners or Visitors shall, after the production of such certificate, give their consent in writing for the removal or discharge of such patient. Under other clauses, additional powers of discharge are given to the Commissioners and Visitors, subject to such restrictions, as to leave the control for the most part in the hands of professional men. These powers of discharge do not, however, apply either to

criminal lunatics, or to those found insane under a commission issued by the Lord Chancellor.

INTERDICTION.—By interdiction we are to understand the depriving a person labouring under mental disorder, of his civil rights; in other words, preventing him from exercising any control or management over his affairs. It may be with or without restraint, for one condition does not necessarily imply the other. When an individual, from mental incompetency, is liable to be imposed upon by others, or is guilty of foolish and extravagant acts, whereby his property is damaged, a Commission is commonly granted by the Court of Chancery, in order to determine, whether he be "*compos*" or "*non compos mentis.*" This writ is well known under the name of "*de lunatico inquirendo.*" Before it can be issued, it is necessary among other matters, that there should be affidavits made by two or three physicians or surgeons certifying to the insanity of the party. It has been already explained that the object of the law, is to determine whether the incapacity to manage affairs, be owing to some mental defect or disorder, and not merely to want of education or bodily infirmity,—otherwise all wealthy minors and infirm persons might be improperly deprived of the control of their affairs. It is unfortunate that these commissions are conducted on so expensive a scale, as to render them only applicable to the wealthy classes of society; and even here the expenses attending such a simple inquiry as that for which the commission is issued, are often of the most ruinous kind, and the results are by no means satisfactory. (See the cases of *Mr. Davies, Miss Bagster* and others.) When insanity is pleaded in a criminal case, one judge and twelve jurors will decide the question, affecting as it does the *life* of a party, in a few hours and at very little expense! It is difficult to understand why in a question of competency to manage affairs, so many more functionaries should be required, so much more time, sometimes amounting to twelve or fifteen days, occupied, so many witnesses examined, and such enormous expenses should be thereby incurred. (See cases of *Lady Kirkwall,* Feb. 1836, and of *Miss Bagster,* July 1832.) One source of difficulty on these occasions is, that medical witnesses are allowed to be summoned by both the parties, and the opinions given, often exactly neutralize each other; they are hereby converted into partisans in the cause, as much so as if they were counsel. It has been well remarked, that a man, even unknown to himself, with the purest intentions and the most perfect rectitude, will insensibly lean to the side on which he has been employed. (Pagan, 301.) The public are apt to infer from such conflicting opinions being given by men of equal experience, that the difference cannot depend essentially on the medical facts of the case; and that the question might be better determined by non-professional persons. (See the case of *Carpenter,* Dublin Med. Press, July 16, 1845, p. 46.) A remedy for this serious evil would be, that medical witnesses on such occasions should be appointed, like the Commissioners, by the Chancellor, and they would be thereby made equally independent of both parties. At present they rather occupy the position of

medical counsel than medical witnesses; for it is quite clear, that not one would be summoned, whose views did not coincide exactly with those of the party summoning him; and it is an opinion among some solicitors, for which, unfortunately, there is apparent reason, that medical evidence on these occasions is a marketable commodity, and may be purchased at graduated prices! The reader will find some excellent remarks on this subject in the Medical Gazette, v. 719; xi. 740; and xvii. 816.

To determine whether or not a person is a fit subject for interdiction, it is necessary to bear in mind, that it is not enough to show there is delusion, as in the lighter cases of monomania; but we are bound to determine how far that delusion affects the judgment of a party so as to prevent him like other men from managing his affairs with provident care and propriety. In many instances, however, proof of delusion only is sought for; and if this be procured, it is somewhat hastily inferred, that the party is entirely incompetent to the management of his property. The most difficult cases are those involving questions of imbecility. In conducting the examination of an alleged lunatic, we should compare his mind as it is with what it has been; and if it be a case of supposed imbecility, a proper regard must be had to age, society, education and general conduct. We should also consider whether the person has been treated by his friends and relations as a lunatic or imbecile, prior to the issuing of the commission. A young person, whose education has been neglected, and who has never been entrusted with the care of money, cannot be expected to have much knowledge of the method of managing a large property. Questions are sometimes put on the moral responsibility of man and the attributes of God to one, who, perhaps, never heard of metaphysics. Arithmetical questions are asked which would embarrass many persons who are set down as sane and competent. In a case which occurred a few years since, one examiner asked the alleged imbecile, who said he had £1,200 in the bank and received £20 for interest,—How much that was per cent? He said "he could not tell; he was no good hand at arithmetic." The counsel who appeared against the brieve or commission, afterwards put the same arithmetical question to one of the medical witnesses who had deposed to the imbecility of the party; and this witness, an educated man, confessed himself unable to answer it,—a practical illustration of the impropriety of pronouncing a person to be imbecile, merely because he is ignorant of what he has never been taught! (Case of *David Yoolow*, 1837.) If the capacity to manage affairs rested solely upon a knowledge of arithmetic, many now go free, who ought to be immediately placed under interdiction. This is rather a commercial test of insanity: but it will be found that it has been applied in a very improper way, to determine the capacity of young and ill-educated females. Unless the questions be confined to those subjects which the party has had either the opportunity or inclination to learn, a medical witness will always incur the risk of confounding mere ignorance with imbecility. Perhaps one of the

best tests of mental capacity will be found in determining the degree to which, with ordinary opportunities, the individual has shown himself capable of being instructed. Too high a standard must not be assumed as a test for capacity. The mind of an alleged imbecile should not be compared with the most perfect mind; but with that of another person of average capacity, of the same age and station in society, and who has enjoyed like opportunities of instruction. (See Ann. D'Hyg. 1836, i. 192.)

A medical witness must not allow himself to be embarrassed by medical or legal definitions of insanity. The malady may not have the form of strict lunacy or idiocy in a legal view; nor of mania, monomania, dementia, or idiocy in a strict medical view; but still it may be a case of *such mental disorder*, as to create *an incapacity for managing affairs*. This is the point to which a medical examiner has to direct his attention. Dr. Conolly has suggested one method of testing the state of mind, which it would be advisable to adopt, namely, to cause the individual to express his thoughts in writing. He would not here be led to suspect that he was being subjected to an examination for a hostile purpose. In many cases the evidence of a strong delusion existing in the mind, has been derived from a will, deed or letters written spontaneously by the lunatic or imbecile, when there was considerable difficulty in obtaining this proof by a verbal examination. Many cases might be here cited to illustrate the medical evidence required and received on commissions of lunacy. One may be selected which excited much interest at the time of its occurrence,—I allude to that of *Miss Bagster*, which underwent inquiry in July 1832. It will serve to show upon what slight grounds a verdict of "unsound mind" may be returned under Commissions of lunacy, as they are at present conducted.

The subject of this inquiry was shown by the evidence to be a frivolous and weak-minded girl, whose education had been much neglected. She was heiress to a large fortune, and contracted a clandestine marriage unsuited to her condition. A commission was taken out by her friends for the purpose of annulling her marriage, by showing that she was not at the time competent to give rational consent. The general evidence established that there had been great neglect in her education, and that she had been especially indulged; but it did not appear that she had ever been treated by her friends as of unsound mind, nor indeed that any question of her insanity had been raised until after the marriage. Seven medical witnesses, summoned to support the commission, deposed that she was of unsound mind. On the other side, no witnesses were called, as it was considered that the allegation of insanity was not made out. The Commissioners, however, themselves called Dr. Morison and Dr. Haslam, who deposed that her incompetency to manage her affairs arose not from unsoundness of mind, but from ignorance. She gave one strong proof of her sanity, namely, that she was aware of her deficiencies. It seems to have been allowed that she was capable of controlling herself, and concealing her defects; her answers to the questions put to her were pertinent, and were for the most part correctly made, and she had capacity to receive instruction. She was ignorant of arithmetic, but this she had never been properly taught. She was young and inexperienced, and therefore unable to answer questions relative to the management of a household. The

jury, by a majority of twenty to two, returned that she was of unsound mind, and had been so for two years, a time which covered the period of her marriage (See for an excellent medico-legal report of this case Med. Gaz. x. 519, et seq.) It is worthy of remark, that the only two medical witnesses, independent of both sides, who were summoned by the Commissioners, gave a very strong opinion that Miss Bagster was *ignorant*, and not of unsound mind, and that she might by instruction become competent to the management of her affairs. We should imagine that where the question arose, whether a young person was or was not to be deprived of all civil rights, there ought to be at least unanimity among the medical opinions, or, if this were denied, then more weight should be given to the negative than to the affirmative side of the question, providing, if, as in this case, the negative view were supported by men impartially selected, and of great experience and knowledge on the subject of insanity. It is not improbable, that besides ignorance, there may have been some degree of weakness of mind about this person; yet, taking the whole case, we must attribute the verdict of unsoundness, not so much to mental infirmity as to incapacity, for want of instruction, to manage a large fortune. But if every wealthy young lady whose education had been much neglected, had her sanity tested on the same points as Miss Bagster, it is certain that many who are now free agents, would be placed under interdiction! It has been attempted to justify the verdict by the statement that it saved her from the results of an imprudent marriage—the answer to which is, that Commissions of *lunacy* are not intended to shield persons, whose minds are not really unsound, from the results of foolish and imprudent acts.

Commissions may be superseded, but the evidence in such a case must be as strongly in favour of sanity, as it was before in favour of insanity. In *Dyce Sombré's* case, July, 1844, the physicians of England and France came to directly opposite conclusions! See the judgment of the Lord Chancellor. (Law Times, Sept. 28, 1844.) There have been few cases in which so great a difference of opinion existed among medical witnesses as this. Five English medical practitioners of good standing were, however, in favour of the sanity of the party. The decision was against superseding the commission, chiefly on the ground of the existence of delusion.

Lucid intervals.—By a lucid interval, we are to understand a temporary cessation of the insanity or a perfect restoration to reason. Thus, then, it differs entirely from a remission, in which there is a mere abatement of the symptoms. It has been said that a lucid interval is only a more perfect remission; and that although the lunatic may act rationally and talk coherently, yet his brain is in an excitable state; and he labours under a greater disposition to a fresh attack of insanity, than one whose mind has never been affected. Of this there can be no doubt; and the same reasoning would tend to show that insanity is never cured; for the predisposition to an attack is undoubtedly greater in a recovered lunatic, than in one who is and has always been perfectly sane. Even admitting the correctness of this reasoning, it cannot be denied that lunatics do occasionally recover for a longer or shorter period, to such a degree as to render them perfectly conscious of, and legally responsible for their acts like other persons. The law intends no more than this by a lucid interval: it does not

require proof that the cure is so complete as that even the predisposition to the disease should be entirely extirpated. Such proof, if it could even be procured, would be totally irrelevant. If a man acts rationally and talks coherently, we can have no better proof of a restoration to reason. If no delusion affecting his conduct remain in his mind, we need not concern ourselves about the degree of latent predisposition to a fresh attack which may still exist.

Lucid intervals sometimes appear suddenly in the insane:—the person feels as if awakened from a dream, and there is often a perfect consciousness of the absurdity of the delusion under which he was previously labouring. The duration of the interval is uncertain; it may last for a few minutes only, or may be protracted for days, weeks, months, and even years. In a medico-legal view its alleged existence must always be looked upon with suspicion and doubt, when the interval is very short. These lucid intervals are most frequently seen in cases of mania and monomania—they occasionally exist in dementia when this state is not chronic, but has succeeded a fit of intermittent or periodical mania. They are never met with in cases of idiocy and imbecility. It is sometimes a matter of great importance to be able to show whether or not there exists or has existed a lucid interval; since under these circumstances, the acts of an individual are deemed valid in law. The mind should be tested, as in determining whether the patient be labouring under insanity or not. He should be able to describe his feelings, and talk of the subject of his delusion without betraying any signs of unnecessary vehemence or excitement. It may happen that a person who is the subject of a Commission of inquiry, is at the time of examination under a lucid interval, in which case there may be some difficulty in forming an opinion of the existence of insanity. This occurred in the case of *Lady Seymour* (July, 1838);—when examined before the Commission, her replies were so rational and collected, that no verdict could be given, and the case was adjourned. When the inquiry was resumed, it was satisfactorily proved that she was insane, not merely by general and medical evidence, but by the terms of her will, which had been drawn up by herself. The same circumstance happened in the cases of *Mrs. Hartley* and *Mr. Pearce*, who were the subjects of Commissions in 1843. It has been said that a person in a lucid interval is held by law to be responsible for his acts, whether these be of a civil or criminal nature. In regard to criminal offences committed during a lucid interval, it is the opinion of some medical jurists that no person should be convicted under such circumstances; because there is a probability that he might at the time have been under the influence of that cerebral irritation which renders a man insane. (Prichard.) This remark applies more especially to those instances where the lucid interval is very short. Juries now very seldom convict, however rationally in appearance a crime may have been perpetrated, when it is clearly proved that the accused was really insane within a short period of the time of its perpetration.

CHAPTER LX.

RESPONSIBILITY OF THE INSANE FOR CIVIL AND CRIMINAL ACTS.

MARRIAGES.—Insanity is deemed in law to be a civil impediment to marriage, because it is considered that there cannot be that rational consent which is necessary to the validity of the contract. The marriage of a lunatic is therefore called a nullity, and is void *ab initio*. All that the law requires is, that there should be good proof of insanity at or about the time of the contract. If this be offered, and it be then alleged that the contract was entered into during a lucid interval, then the party who would benefit by the allegation must prove it. The suitableness of the marriage, as well as the conduct of the party during or after its performance, will also be considered by the Court. In the case of *Turner* v. *Myers*, a lunatic who had recovered from his lunacy, instituted a suit to set aside a marriage which he had contracted while in that state! The marriage was declared void. (Med. Gaz. viii. 481.)

WILLS.—Questions involving the *testamentary capacity* of individuals are of very frequent occurrenee, and medical evidence is commonly demanded. When property is bequeathed by a testator out of the usual order of succession, it may be alleged by the relatives that he was wholly incompetent to understand the nature of the deed—whether from actual insanity, the imbecility of age, or that natural failure of the mind which is so often observed to occur on the approach of death. Bodily disease or incapacity does not affect the validity of a will, unless the mind be directly or indirectly disturbed by it. Some years ago a case occurred in France, in which a will was contested on the ground that the testator, when he executed it, was labouring under erysipelas. The opinion of Esquirol was demanded, and he said that erysipelas might undoubtedly affect the brain, a fact clearly indicated by the sight, hearing, and other senses becoming weakened; yet this, in his opinion, did not necessarily indicate an impairment of the understanding. (Ann. D'Hyg. 1832, 203.) A man's mind under these circumstances may not be so strong as in robust health, but still it may retain a disposing power. In the case of *Harwood* v. *Baker*, decided by the Privy Council in 1841, a will was pronounced to be invalid, owing to the general state of bodily disease in which the testator was at the time of making it. It appears that he was labouring under erysipelas and fever, and these diseases had produced a degree of drowsiness and stupor which rendered him incompetent to the act. In the case of

Day, June, 1838, epilepsy was alleged to have affected the mind; and in the case of *Blewitt*, March 1833, paralysis was alleged as a ground of incompetency. In all cases of this kind, the law looks exclusively to the actual *effect* of the bodily disease upon the *mind*, and this is commonly a purely medical question. In the case of *Penfold v. Crawford*, C. P. Dec. 1843, it was shown that the testator had lost his speech from an attack of apoplexy; but it was proved by medical evidence that his mental powers were good, and therefore a deed made subsequently to the attack, was held to be valid. *Integritas mentis non corporis sanitas exigenda est.*

A person is considered to be of a sane and disposing mind who knows the nature of the act which he is performing, and is fully aware of the consequences. From some decisions that have been made, it would appear that a state of mind for which a party might be placed under interdiction, would not render him incompetent to the making of a will. The validity of the will of a lunatic was once allowed, although made while he was actually confined in an asylum, because the act was rational, and it was such as the lunatic, some years prior to the attack of insanity, announced his intention of making. (*Coghlan's case.* See also Re *Garden*, Law Times, July 6, 1844, p. 258.) The insanity of a party when not already found insane under a Commission, must not in these cases rest upon presumption, but be established by positive proof. The commission of suicide is often hastily assumed to be evidence of insanity; but it would not be allowed as a proof of this state, even when a testator destroyed himself shortly after the execution of the will. A case has been decided where the testator had committed suicide three days after having given instructions for his will; but the act was not allowed to be a proof of insanity, and the will was pronounced to be valid. A similar case has been thus decided in the French courts. Besides, as we shall see hereafter, suicide is not deemed in law to be a proof of insanity.

The *validity of deeds* executed by persons affected with monomania often becomes a subject of dispute. The practice of the law here indicates that the mere existence of a delusion in the mind of the person does not necessarily vitiate a deed, unless the delusion form the groundwork of it, or unless the most decisive evidence be given, that at the time of executing the deed, the testator's mind was influenced by it. Strong evidence is often derivable from the act itself, more especially where the testator has drawn it up of his own accord. In the case of *Barton*, July 1840, the Ecclesiastical Court was chiefly guided in its decision by the nature of the instrument. The testator, it appeared, laboured under the extraordinary delusion that he could dispose of his own property to himself, and make himself his own legatee and executor! This he had accordingly done. The instrument was pronounced to be invalid. But a will may be manifestly unjust to the surviving relatives of a testator, and it may display some of the extraordinary opinions of the individual, yet it will not necessarily be void, unless the testamentary dispositions clearly indicate

that they have been formed under a delusion. Some injustice may possibly be done by the rigorous adoption of this principle, since delusion may certainly enter into a man's act, whether civil or criminal, without our being always able to discover it; but after all, it is perhaps the more equitable way of construing the last wishes of the dead. The evidence in these cases sometimes amounts to proof of *eccentricity* only on the part of the testator, or in the deed itself; but a clear distinction must be here drawn. The will of an eccentric man is such as might always have been expected from him—the will of one labouring under insanity (delusion) is different from that which he would have made in an unaffected state;—the instrument is wholly different from what it would once have have been.

In the case of a Mr. *Stott*, a medical electrician, whose will was disputed by his daughter, on the ground of insanity, it was proved that the testator fancied he could deliver pregnant women by means of electricity, and he actually proposed to the wife of a baker living in the neighbourhood, to bring about her accouchement by an electrical machine! The will was pronounced invalid, not so much on account of this extreme absurdity, as of the violent and unnatural treatment to which he had subjected his daughter. It appeared that he had taken, as we now and then find in monomaniacs, a most unaccountable and causeless dislike to this girl from her earliest infancy. Strange as it may appear, electricity has been lately used as a means of aiding parturition; but under circumstances very different from those which gave rise to the absurd delusion in the case just related. (Med. Gaz. xxxvi. 376.) It has become a grave question whether proof of *moral insanity*, i. e., a perverted state of the moral feelings or affections, independently of any direct evidence of intellectual disturbance, should be a sufficient ground to set aside the act of a testator. There is a case now pending before the Prerogative Court (Oct. 1845), *Frere v. Peacocke*, in which this is the principal question at issue. The counsel who maintained the validity of the will, argued against the admissibility of Pinel's doctrine of moral insanity, chiefly because there was a difference of opinion among those who adopted the doctrine—whether it was or was not invariably accompanied by some mental derangement. A doctrine thus novel, unsettled, and not sufficiently developed, could not, it was urged, be safely applied to legal questions. If a man who was free from delusions (as the deceased in this case was), and capable of acts of business (as he was), might nevertheless be held to have been insane, it would involve this branch of testamentary law in utter confusion. A man who was not a subject for a commission of lunacy, might be held after death to have been morally insane. The Court would have to deal with cases of kleptomania and pyromania, in which the individuals exhibited no trace of intellectual insanity or delusion of mind. It was safer to rely upon the ancient and general doctrine of these Courts, *that there was no insanity without delusion,—its true criterion;* and that in the present case the deceased, though eccentric, was not of unsound mind.

This reasoning appears to me to be more ingenious than sound. If it were admitted, it would go to the extent of excluding a plea of insanity in many criminal cases in which the Courts have not hesitated to receive it; and therefore it leads to the novel conclusion, that a man affected with moral insanity, who murdered his wife from perverted feeling, would be held irresponsible for the act in *criminal law;* but if, under the *same perverted feeling*, he bequeathed his property to an utter stranger, and left her penniless, the deed would be valid in *civil law*. There does not appear to be any reason why such a distinction should be made; even supposing the decision in the case of Mr. Stott not to be in some respects adverse to it.

Wills are sometimes contested more on the ground of eccentricity than of insane delusion; but if eccentricity only be proved, a Court will not inter-

fere. In the case of *Morgan v. Boys*,1838, it was proved that the testator by his will, had left a large fortune to his housekeeper. The will was disputed on the ground that it bore intrinsic evidence of the deceased not having been in a sane state of mind at the time of making it. After having bequeathed his property to a stranger, the testator directed that his executors should "cause some parts of his bowels to be converted into fiddle-strings,—that others should be sublimed into smelling salts, and that the remainder of his body should be vitrified into lenses for optical purposes!" He further added, in a letter attached to his will—"The world may think this to be done in a spiri of singularity or whim, but I have a mortal aversion to funeral pomp, and I wish my body to be converted to purposes useful to mankind." Sir H. Jenner, in giving judgment, held that insanity was not proved:—the facts merely amounted to *eccentricity*, and on this ground he pronounced for the validity of the will. It was proved that the deceased had conducted his affairs with great shrewdness and ability, that he not only did not labour under imbecility of mind, but that he had been always treated during life as a person of indisputable capacity by those with whom he had to deal. The best rule to guide the Court, the judge remarked, was the conduct of parties towards the deceased; and the acts of his relatives evinced no distrust of his sanity or capacity while he was living. The deceased had always been noted for his eccentric habits, and he had actually consulted a physician upon the possibility of his body being devoted to chemical experiments after death. In the case of *Mudway v. Croft*, Prerog. Court, August, 1843, a will, contested on the ground of insanity, but defended on the plea of eccentricity, Sir H. J. Fust said,—"It is the prolonged departure, without an adequate external cause, from the state of feeling and modes of thinking usual to the individual when in health, that is the true feature of disorder in mind."

Wills made in incipient dementia arising from extreme age (*senile imbecility*) are sometimes disputed, either on the ground of mental deficiency, or from the testator, owing to weakness of mind, having been subjected to control and influence on the part of interested persons. If a medical man be present when the will is made, he may easily satisfy himself of the state of mind of the testator, by requiring him to repeat from memory the way in which he has disposed of the bulk of his property. Medical men have sometimes placed themselves in a serious position by becoming witnesses to wills under these circumstances, without first assuring themselves of the actual mental condition of the testator. It would always be a good ground of justification, if, at the request of the witness, the testator had been made to repeat substantially the leading provisions of his will from memory. If a dying person cannot do this without prompting or suggestion, there is reason to believe that he has not a sane and disposing mind. It has been observed on some occasions, when the mind has been weakened by disease or infirmity from age, that it has suddenly cleared up before death, and the individual has unexpectedly acquired a disposing capacity. (Ann. D'Hyg. 1831, 370.) In the case of *Durnell v. Corfield*, Prerog. Court, July, 1844, where an old man of weakened capacity had made a will in favour of his medical attendant, Dr. Lushington held that there must be the clearest proof not only of the *factum* of the instrument, but of the testator's knowledge of its contents. (Law Times, July 27, 1844.) Wills made by persons whose capacity during life has never been doubted, while lying at the point of death, or as it is termed *in extremis*, are regarded

with suspicion, and may be set aside according to the medical circumstances proved. Many diseases, especially those which affect the brain, or nervous system directly or indirectly, are likely to produce a dulness or confusion of intellect, under which a disposing power is lost. Delirium sometimes precedes death, in which case a will executed by the dying person, would be at once pronounced invalid.

Criminal responsibility.—The rule of law with regard to this subject is, that no man is responsible like a sane person for any act committed by him while in a state of insanity. This is a question of considerable importance in a medico-legal view; for should a plea of insanity be improperly admitted in any criminal case, then punishment is made to fall unequally on offenders; and if, on the other hand, it be improperly rejected, punishment is administered with undue severity. A plea of insanity may be raised for the smallest offence up to the highest crime—murder; but it is rarely raised in respect to smaller offences, because the close confinement to which the offender, if found insane, would necessarily be subjected, would often be a heavier punishment, than that which the law actually prescribes for the offence which he may have committed. In a case of felonious assault lately tried, it was urged by the counsel in defence that the prisoner was insane; but the evidence on this point was not by any means conclusive,—when it was intimated by the Court that if this plea were admitted, the party would probably undergo a much longer imprisonment, than if on conviction, he received the legal punishment for the offence. (See the case of the *Queen* v. *Reynolds,* Bodmin Aut. Ass. 1843.) The judge is reported to have said that there was no proof of insanity. If the prisoner was pronounced insane, he might be imprisoned for life, and therefore he did not think that finding would benefit him! A verdict of guilty was returned, and the man was sentenced to eighteen months' imprisonment. This case shows at least that a defence of this kind may be sometimes indiscreetly put forward. Murder, except by poison, incendiarism, and theft, are the crimes for which this plea has been chiefly raised;—and it has been more especially confined in this country, to those cases where persons have been charged with murder or attempts at murder. The attempt to establish this plea in cases of murder by poison, has generally ended in failure, although there was in one case even proof of hereditary insanity. (*Reg.* v. *Gallop,* Somerset Winter Ass. 1844.) The crime of poisoning indicates malice and deliberation in a greater degree, than it would be in general safe to admit as co-existing with a state of insanity. Alison, however, mentions one case of acquittal (*Sparrow,* 1829), in which this plea was admitted. The woman poured a large quantity of vitriolic acid down the throat of her own child. She then ran to a neighbour's house in a state of evident derangement, saying that she had killed the devil. Her insanity was clearly proved, and she was acquitted (Crim. Law, 648.) It is customary to say that those who commit these heinous crimes while labouring under insanity, are irresponsible. By

this we are not to understand that they are allowed to go free. On the contrary, they are subject to close confinement, commonly perpetual, as it assuredly ought to be in all cases of murder: but depending on their recovery in respect to crimes of less magnitude. A power is vested in the executive only, to discharge recovered lunatics, according to circumstances. This subject will be, perhaps, best considered under the following heads.

I. HOMICIDAL MONOMANIA.—Homicidal monomania is commonly defined to be a state of partial insanity, accompanied by an impulse to the perpetration of murder; but most medical jurists admit that individuals who may not appear to labour under any *intellectual* aberration, are liable to be seized with a sudden destructive impulse, under which they will destroy those to whom they are most fondly attached, or any person who may happen at the time to be involved in the subject of their delusion. Sometimes the impulse is long felt, but concealed and restrained: there may be merely signs of depression and melancholy about the individual, nothing, however, to lead to a suspicion of the fearful contention which may be going on within his mind. Occasionally the murder may be perpetrated with great deliberation, and under all the marks of sanity. These cases are rendered difficult by the fact that there may be no clear proof of the existence, past or present, of any disorder of the mind, so that it would appear the chief evidence of the existence of insanity, is in the act itself:—of the existence of the malady before and after the perpetration of the crime, there may be either no evidence whatever, or it may be so slight as scarcely to amount to proof. These cases are regarded as instances of insanity of the moral feelings only, and this condition is called "*Moral insanity.*" An unrestricted admission of this doctrine would, it is alleged, go far to do away with all punishment for crime, for it would then be impossible to draw a line between insanity and moral depravity, and the law will not at present excuse an act committed through moral depravity. The works of Marc, Esquirol and Prichard abound in illustrations of this form of monomania; but I prefer selecting some of those which have occurred in England. The following case was tried on the Midland Circuit, July, 1837. (*Reg.* v. *Greensmith.*)

A man named *Greensmith* was charged with the murder of four of his young children. The facts here to be related were partly brought out in evidence, and partly by his own confession. He was a person of industrious habits and an affectionate father; but having fallen into distressed circumstances, he destroyed his children by strangling them, in order, as he said, that they might not be turned into the streets. The idea only came to him on the night of his perpetrating the crime. After he had strangled two of his children in bed, he went down stairs, where he remained some time; but thinking that he might as well suffer for all as for two, he returned to the bedroom, and destroyed the two whom he had left alive. He shook hands with them before he strangled them. He left the house and went to a neighbour's, but said nothing of the murder, until he was apprehended the next day and taken before the coroner, when he made a full confession. Not one of the witnesses had ever observed the slightest indication of insanity

about him. He made no defence, but several humane medica practitioners came forward to depose that he was insane. The surgeon of the gaol said that the man was feverish, complained of headache, and had been subject to disturbed sleep and sudden starts since the death of his wife, a short time before. He spoke of the crime he had committed without the slightest excitement, and the witness said he had heard enough of the evidence to satisfy him that the prisoner could not have committed such a crime as this, and be in a sane state of mind. Dr. Blake, physician to the Nottingham Lunatic Asylum, said he was satisfied that the prisoner laboured under a delusion of mind. The prisoner's grandmother and sister had been under his care, the latter for entertaining a similar delusion, namely, that of destroying herself and her children. The judge declined receiving this evidence; and under his direction the prisoner was found guilty, and sentence of death was passed upon him. By the active interference of Dr. Blake and others, he was respited on the ground of insanity. (See Med. Chir. Rev. xxviii. 84.) For precisely analogous cases, followed by acquittals, see *Reg. v. Frost*, Norwich Summer Ass. 1844; and *Reg. v. Dickenson*, C. C. C., March, 1844. Other examples of homicidal monomania might be found in the cases of *Nicholas Steinberg*, who cut the throats of his wife and four children, and then destroyed himself, in Sept. 1834,—of *Lucas*, who destroyed his three children in March, 1842; and of a man named *Giles*, who cut the throats of two of his infant children at Hoxton, in January, 1843. In all of these cases, the unexpected act of murder was accompanied by suicide. They may be regarded as fearful examples of homicidal mania, in which there were no previous symptoms of *intellectual aberration* indicative of insanity, under the common meaning of the term, or any irregularity of conduct on the part of the homicides, to justify the least interference with their civil liberty. One remarkable feature in these unrecognizable cases is, that the murderous act is commonly directed against those who are most closely connected with the homicides in blood, and to whom they are attached by the tenderest ties.

It is impossible that such crimes as these can be regarded as the acts of *sane* individuals; and even those who are the most sceptical on the existence of such a form of insanity as *homicidal monomania*, are compelled to admit that these dreadful, motiveless murders are the acts of insane, and therefore irresponsible agents. It may be a dangerous doctrine to adduce the *crime* as *evidence* of insanity, but these cases incontestably prove that there are some instances in which this is the only procurable evidence. (See also *Reg.* v. *Brixey*, C. C. C., May 1845, post, p. 673.) Had not the homicides destroyed themselves, it is almost morally certain, that they would have been acquitted on the ground of insanity. In the case of *Staninought* this actually took place—this man who had attempted suicide recovered, was tried and acquitted on the ground of insanity, but afterwards destroyed himself.

Causes.—The causes of homicidal monomania are assigned by Esquirol to cerebral irritation induced by bodily disease, (case by Mr. Daniell, post, p. 670,) excessive nervous excitement, vicious education, erroneous notions of religion, grief, destitution, and the power of imitation. With respect to the latter, it is a fact that the publicity given to horrible occurrences often excites the homicidal feeling. (See case *Hon. R. Touchett*, post, p. 672.) The sight of a weapon, or of the intended victim, also determines in an instant the perpetration of the crime,—the individual feeling himself drawn on by an impulse which he can

neither resist nor control. Disordered menstruation, by sympathy of the uterus with the brain, may likewise operate as a cause; and this it is the more important to observe, because the individual may not have previously manifested any sign of intellectual or moral insanity. (Case of *Brixey*, post, p. 673.) Esquirol alludes to the case of a female who at every menstrual period experienced a strong desire to kill her husband and children, especially when she saw them lying asleep. Parturition is likewise a cause, and in this case the disorder assumes the form of what is called PUERPERAL MANIA. (See post.) It is important for the medical jurist to bear in mind, that persons who are likely to be attacked by homicidal monomania, are not always characterized by a gloomy, melancholic, or irritable disposition: the disorder sometimes shows itself in those who have been remarkable for their kind and gentle demeanour and quiet habits. Thus, then, in these cases, the murderous disposition gives no warning of its existence: this may, however, be sometimes indicated by a sudden change of character.

Symptoms.—Homicidal monomania may make its appearance *at all ages*, even in children not more than eight or ten years old:—it is usually periodical, and the paroxysm is preceded by symptoms of general excitement. The patient experiences colicky pains, a sense of heat in the abdomen or chest—headache, restlessness,—the face is flushed or very pale,—the pulse hard and full, and the whole body in a state of convulsive tremor. An act of violence is committed without warning, and the patient appears as if relieved from some oppressive feeling. He may be calm and express neither regret, remorse nor fear. He may coolly contemplate his victim, confess the deed, and at once surrender himself to justice. In some rare instances he may conceal himself, hide the weapon, and endeavour to do away with all traces of the crime. The symptoms just described have been observed to become more aggravated in proportion as the homicidal impulse was strong. The propensity to kill is sometimes a fixed idea, at others intermittent, and the patient can no more banish it from his thoughts than can a person affected with insanity, divest himself of the delusive ideas which occupy his mind. (Esquirol ii. 105.)

Legal and medical tests.—Admitting then the existence of this state of homicidal monomania, it will become a question, how, when pleaded for one charged with murder, it is to be distinguished from a case where the crime has been perpetrated by a really sane person. Tests, both medical and legal, have been proposed. The *legal test* has been lately explicitly given by the whole of the judges in conference, in answer to queries put by the House of Lords in reference to the case of *M'Naughten*, tried and acquitted on the ground of insanity. (June 19th, 1843.)

The jury ought in all cases to be told that every man should be considered of sane mind until the contrary were clearly proved in evidence. That before a plea of insanity should be allowed, undoubted evidence ought to be adduced that the accused was of diseased mind, and that at the time he committed the act, *he was not conscious of right or wrong.* Every person was supposed to

know what the law was, and therefore nothing could justify a wrong act, except it was clearly proved that the party did not know right from wrong. If that was not satisfactorily proved, the accused was liable to punishment. If the *delusion* under which a person laboured, were only *partial*, the party accused was equally liable with a person of sane mind.

It would appear from this that the law, in order to render a man responsible for a crime, looks for a *consciousness of right and wrong, and a knowledge of the consequences of the act.* Thus, as it was laid down by the judge in *Greensmith's* case, the complete possession of reason is not essential to constitute the legal responsibility of an offender; and it is also to be inferred from the results of several cases, that a man may be civilly incompetent, but sufficiently sane to be made criminally responsible. The proofs required in the two cases, are essentially distinct. It has been very properly objected to this *legal test,* that it is insufficient for the purpose intended: it cannot, in a large majority of cases, enable us to distinguish the insane homicide from the sane criminal. Many insane persons have committed acts which they knew to be wrong, and of the criminality of which they were at the time perfectly conscious. They have been known to murder others, in order to receive the punishment of death at the hands of the law; and, therefore, they must have known that the act which they were perpetrating, was an offence against the law of man. In short, the criminal nature of the act has often been the sole motive for its perpetration! (See case Ann. D'Hyg. 1842, i. 363.)

In *Greensmith's* case (antè, p. 662.) there was no doubt that the man knew he was doing wrong and what was contrary to law; for after having murdered two of his children, he returned and murdered the others, considering that he might as well suffer for all as for two! The case of *Hadfield,* who was tried for shooting at George III. and acquitted on the ground of insanity, furnishes another striking example of the existence of insane delusion, coupled with a full knowledge of the consequences of the act which he was about to commit. He knew that in firing at the king, he was doing what was contrary to law; and that the punishment of death was attached to the crime of assassination; but the motive for the crime was that he might be put to death by others,—he would not take his own life. Again, *Martin,* the incendiary, admitted that he knew he was doing wrong according to the law of man, when he set fire to York Cathedral: he was conscious that the act was illegal, but he said he had the command of God to do it. Thus then we find a full consciousness of the illegality or wrongfulness of an act, may exist in a man's mind, and yet he may be fairly acquitted on the ground of insanity. It will now be proper to examine the *tests* which have been proposed by medical jurists, for detecting these cases of homicidal mania.

1. The acts of homicide have generally been preceded by other striking *peculiarities of conduct* in the individual, often by a total change of character. 2. They have in many instances previously or subsequently attempted *suicide:* they have expressed a wish to die or to be executed as criminals.

These supposed criteria have been repeatedly and very properly rejected, when tendered as proofs of insanity in Courts of law. They are of too vague a nature, and apply as much to cases of moral depravity as of actual insanity: in short, if these were admitted as *proofs*, they would serve as a convenient shelter from punishment for many sane criminals.

3. These acts are without *motive*: they are in opposition to all human motives. A man murders his wife and children known to have been tenderly attached to them: a mother destroys her infant.

It is hereby assumed or implied that sane men never commit a crime without an apparent motive; and that an insane person never has a motive, or one of a delusive nature only, in the perpetration of a criminal act. If these positions were true, it would be very easy to distinguish a sane from an insane criminal; but the rule wholly fails in practice. In the first place, the *non-discovery* is here taken as a proof of the *non-existence* of a motive: while it is undoubted that motives may exist for many atrocious criminal acts without our being able to discover them, a fact proved by the numerous recorded confessions of criminals before execution, in cases where, until these confessions had been made, no motive for the perpetration of the crimes had appeared to the acutest minds. In the case of *Courvoisier*, who was convicted of the murder of Lord William Russell in June, 1840, it was the reliance upon this alleged criterion, before the secret proofs of guilt accidentally came out, that led many to believe he could not have committed the crime; and the "absence of motive" was urged by his counsel as the strongest proof of the man's innocence. It was ingeniously contended "that the most trifling action of human life, had its spring from some motive or other." This is undoubtedly true, but it is not always in the power of a man untainted with crime, to detect and unravel the motives which influence criminals in the perpetration of murder. No reasonable motive was ever discovered for the atrocious murders and mutilations perpetrated by *Greenacre* and *Good*, yet these persons were very properly made responsible for their crimes! On the trial of *Francis* for shooting at the Queen, the main ground of the defence was, that the prisoner had no motive for the act, and therefore was irresponsible, but he was convicted. It is difficult to comprehend under what circumstances any motive for such an act as this could exist: and therefore the admission of such a defence would have been like laying down the rule, that the evidence of the perpetration of so heinous a crime, should in all cases be taken as a proof of an irresponsible state of mind! Crimes have been sometimes committed without any apparent motive, by sane individuals, who were at the time perfectly aware of the criminality of their conduct. No mark of insanity or delusion could be discovered about them, and they had nothing to say in their defence. They have however been very properly held responsible. On the other hand, lunatics confined in a lunatic asylum have been known to be influenced by motives in the perpetration of crimes. Thus

they have often murdered their keepers out of revenge for ill-treatment which they have experienced at their hands. (See the case of the *Queen* v. *Farmer*, York Spring Assizes, 1837.) This man was acquitted as insane, while the clear motive for the homicide was revenge and ill-feeling; or the act may be perpetrated out of jealousy. (*Reg.* v. *Goule*, Durham Summer Ass. 1845.) On the whole, the conclusion with respect to this assumed criterion is, that an absence of motive may, where there are other strong evidences of insanity, favour the view of irresponsibility for crime; but the non-discovery of a motive for a criminal act, cannot of itself be taken as any proof of the existence of homicidal monomania in the perpetrator. It is right to state, however, that the law invariably acts on this humane principle;—the absence of a sufficient motive affords a strong presumption of innocence, —the presence of one is no proof of guilt.

4. The subsequent conduct of the individual:—he seeks no *escape*, delivers himself up to justice, and acknowledges the crime laid to his charge.

This is commonly characteristic of homicidal mania; for by the sane criminal every attempt is made to conceal all traces of the crime, and he denies it to the last. A case occurred in September 1843, which, however, shows the fallacy of this criterion. A man named *Dadd*, murdered his father at Cobham, under circumstances strongly indicative of homicidal mania: he fled to France after the perpetration of the crime, and has since been tried and acquitted on the ground of insanity. (See also another case, Ann. D'Hyg. 1829, ii. 392.) On the other hand, it must be remembered that sane persons who destroy the lives of others through revenge or anger, often perpetrate murder openly, and do not attempt to deny or conceal the crime; for they know that denial or attempt at concealment would be hopeless. Again, a morbid love of notoriety will often induce sane criminals to attempt assassination under circumstances, where the attempt must necessarily be witnessed by hundreds, and there can be no possibility of escape. The recent attacks made on the life of the Queen, are sufficient to bear out this statement.

5. The sane murderer has generally *accomplices* in vice or crime; the homicidal monomaniac has not.

Upon this it may be observed that some of the most atrocious murders committed in modern times, as those perpetrated by *Greenacre*, *Good*, *Courvoisier*, and others, were the acts of solitary individuals, who had neither accomplices nor any assignable inducements leading to the commission of the crimes. It is, however, a fact so far in favour of the existence of homicidal insanity that the *insane* never have accomplices in the acts which they perpetrate. These criteria can hardly be described as medical;—they are circumstances upon which a non-professional man may form as safe a judgment, as one who has made insanity a special study.

The presence of *delusion* has been said to characterize an act of homicidal monomania, while premeditation, precaution, and concealment have been considered the essential features of the act of a sane criminal. With respect to delusion, it has been decided that the mere proof of the existence of this does not excuse the act: if the delusion be *partial*, the party accused is still responsible;—and if the crime were committed for an imaginary injury he would be held equally responsible. (See ante, p. 665.) Much stress was formerly laid upon the *delusion being connected with the act* in cases of insanity; but it must be remembered that, except by the confessions of insane persons during convalescence, it is not commonly easy for a *sane mind* to connect their most simple acts with the delusions under which they labour. Every act of homicide perpetrated by a really insane person is doubtless connected with some delusion with which he is affected; but it by no means follows, that one who is sane should always be able to make out that connection; and it would be therefore unjust to rest the irresponsibility of the accused, upon an accidental discovery of this kind. Let the following cases show how little a sane person is able to connect the delusions of the insane with their acts. Marc mentions that a patient of his was continually in the habit of licking the plaster from the walls of his cell,—in some places they had been licked quite bare by this disgusting practice. It was only accidentally discovered that the act was connected with a delusion, under which he laboured, that he was licking and tasting the most delicious fruits! Another patient was in the habit of running up and down the ward beating his own shadow with a stick. It turned out that he fancied this shadow to be an army of rats in constant pursuit of him! As having closer reference to the present subject, I may refer to the case of a young man, upon whom an inquisition was held in 1843. He was a person of mild manners and he laboured under a delusion connected with windmills. He would go any distance to see a windmill, and would sit watching one for days together. His friends removed him to a place where there were no mills, in the hope that this strange propensity would wear away. He enticed a child into a wood, and in attempting to murder it, cut and mangled its limbs with a knife in a horrible manner. How would any sane person have connected this delusion respecting windmills with attempted murder? Yet it turned out that he had taken the resolution to commit this horrible crime, in the hope that he should be removed as a punishment to some place where there would be a mill! (See Report on Lunatics, Quart. Rev. 1844.) Lord Erskine's doctrine in *Hadfield's* case is therefore, medically speaking, wholly untenable. The connection of delusion with the act may exculpate an accused party; but the non-establishment of this connection proves nothing. It may be further observed that premeditation and precaution are met with in crimes committed both by sane and insane criminals; although these, with subsequent concealment, are certainly stong characteristics of sanity. It is also a question, whether, when they are proved to have existed in any criminal act, there might not have been such a

power of self-control in the individual as to justify the application of punishment. Are such individuals more beyond the influence of example than one-half of the criminals who are punished?

The foregoing considerations lead to the inference, that there are *no certain legal or medical rules*, whereby homicidal mania may be detected. Each case must be determined by the circumstances attending it: but the true test for irresponsibility in these ambiguous cases appears to be, whether the individual, at the time of the commission of the crime, had or had not a *sufficient power of control to govern his actions*. If from circumstances it can be inferred that he had this power, whether his case may fall within the above rules or not, he should be made responsible and rendered liable to punishment. If, however, he was led to the perpetration of the act by an *uncontrollable* impulse, (lésion de volontè, Esquirol,) whether accompanied by deliberation or not, then he is entitled to an acquittal as an irresponsible agent. The power of controlling an act appears to me to imply the existence of such a state of sanity, that unless there be strong evidence of insanity from other circumstances, the party should be held responsible. It is said that this rule would not apply to cases of *intellectual* insanity; but the proof here might be derived from other sources, such as the existence of delusion. The rule is applicable to those cases in which it is most wanted, i. e. of moral insanity; and in one instance there were no other facts upon which a verdict could be founded. (*Reg.* v. *Brixey*, Cent. Crim. Court, May 1845.) A test somewhat similar to this, is constantly applied by juries, under the direction of our judges, to distinguish murder from manslaughter; and it is quite certain, that sanity and homicidal mania are not more nicely blended, than are occasionally the shades of guilt whereby murder passes into manslaughter. The manner in which a crime is committed, will often allow a fair inference to be drawn, as to how far a power of self-control existed. A man in a violent fit of mania rushes with a drawn sword into an open street, and stabs the first person whom he meets;—another, worn out by poverty and destitution, murders his wife and children to prevent them from starving, and then probably attempts to murder himself,—these are cases in which there is fair ground to entertain a plea of irresponsibility; but when we find a man (*Reg.* v. *M'Naughten*) lurking for many days together in a particular locality, having about him a loaded weapon,—watching a particular individual who frequents that locality,—a man who does not face the individual and shoot him, but who coolly waits until he has an opportunity of discharging the weapon unobserved by his victim or others,—the circumstances appear to show such a perfect adaptation of means to ends, and such a power of controlling his actions, that one is quite at a loss to understand, why a plea of irresponsibility should be admitted except upon the fallacious ground, that no motive could be discovered for the act,—a ground, however, which was not allowed to prevail in the case of Francis, and the perpetrators of other atrocious crimes!

There is no novelty in the test here proposed; it is more or less ad-

vocated by Esquirol, Marc, Ray, and the best writers on the Medical Jurisprudence of insanity. Esquirol makes three forms of homicidal monomania: 1. depending on aberration of intellect; 2. on perverted moral feelings; 3. on diseased volition depriving the individual of his moral liberty, i. e. the power of controlling his actions (impuissance de la volonté qui prive l'homme de sa liberté morale. Maladies Mentales, ii. 842.) M. Marc adopts throughout the opinions of Esquirol. (De la Folie, ii. 71.) Dr. Ray, an intelligent American writer, considers that all forms of homicidal monomania are characterized by an "*irresistible* motiveless impulse to destroy life;" (Med. Jur. of Insanity, 268;) and Dr. Pagan properly observes,—"The very loss of the *control over our actions* which insanity infers, is that which renders the acts which are committed during its continuance, undeserving of punishment." (Med. Jur. of Insanity, 211.) Thus, then, it would appear we have here the criterion whereby the responsibility or irresponsibility of an accused party ought to be tested; and although there will be some difficulty in determining how far the individual did or did not possess control over his act;—whether the impulse was or was not irresistible, (impuissance de la volonté;) yet it must be borne in mind that the same objection applies with equal force not only to the present legal test, (the existence or non-existence of a *consciousness of right or wrong* under which persons are yearly acquitted or executed,) but to every test or rule, medical or legal, that has yet been proposed by physician or jurist.

Cases in illustration.—It is well known that individuals seized with a desire to kill, have been able, in some instances, to exercise a certain degree of control over the impulse, and have thus saved the lives of their intended victims, and themselves from the imputation of a heinous crime. Among many cases of this description to be found in medico-legal works, there is perhaps none which illustrates the statement more forcibly than the following by Mr. Daniell. A patient labouring under disordered liver, but no sign of intellectual aberration, was found by him to be on one occasion in a state of great excitement. He confessed that while talking with his wife and family, his eye caught the poker,—a desire to shed blood came upon him which he felt he could not control. He shut his eyes and tried to think of something else, but it was of no use. At last he could bear it no longer, and with a voice of thunder he ordered them out of the room. Had they opposed him, he felt that he must have murdered them all. (Prov. Med. Jour. Nov. 12, 1845.) This was a sudden fit of homicidal monomania, and it presents a fearful picture of the contending feelings which agitate an individual labouring under it. There was here, it will be observed, not an entire deprivation of self-control, or he would have attacked his wife and children without giving them any warning. (For other cases see Esquirol, Maladies Mentales, ii. 807.)

Much difference of opinion existed relative to the case of *M'Naughten*, who was tried for the murder of Mr. Drummond, (Jan. 7, 1843,) and acquitted on the ground of insanity. There is hardly a doubt that had the deceased given any personal offence to this individual, before the perpetration of the act, he would have been convicted; if the deceased, from feeling annoyed at his following him, had struck him or pushed him away before the pistol was fired, it is most probable that the plea of insanity would not have been received. In the acquittal of this man, it is evident that considerable importance was attached to the non-discovery of a motive; for had any kind of motive been apparent, it is pretty certain that an alleged "homicidal climax," *occurring*

at the particular moment when the deceased's back was turned, and after several days' watching on the part of the assailant, would not have been admitted as a sufficient exculpatory plea! If we except the case of *Oxford*, tried for shooting at the Queen, there is perhaps no case on record in English jurisprudence where the facts in support of the plea of insanity were so slight; and when the cases of *Bellingham*, *Lees*, and *Cooper*, are considered, the two latter tried and executed within the last few years, it must be evident that there are both uncertainty and injustice in the operation of our criminal law. Either some individuals are most improperly acquitted on the plea of insanity, or others are most unjustly executed. If the punishment of death were abolished there is no doubt that less would be heard of this plea; but in the mean time, it is unfortunate that there is no other way of avoiding capital punishment, than by making it appear that the criminal is insane! (See Prichard, 399.) It is on this point that medical witnesses seem to me to lose sight of their true position. In giving an opinion of the mental condition of an offender, it is no part of their province to model that opinion, according to the *punishment* which may follow if the plea be rejected, but according to the *facts* of the case. The legislature only is responsible for the punishment adjudged to crimes. One great evil is that under this system, the law operates most unequally. One case becomes a subject of prominent public interest, and every exertion is made to construe the most trivial points of character into proofs of insanity: an acquittal follows. Another case tried at the assizes, may excite no interest,—it is left to itself,—the accused is convicted, and either executed or otherwise punished; although the evidence of insanity, had it been as carefully sought for and brought out, would have been as strong in this, as in the former instance. (*Reg.* v. *Stolzer*, Cent. Crim. Court, Nov. 1843; also *Reg.* v. *Laurence*, Lewes Lent Ass. 1844, infra.) That this kind of defence is being carried too far, will be apparent from the observation of Mr. Baron Gurney, in the case of the *King* v. *Reynolds*, where the judge said that "the defence of insanity had lately grown to a fearful height, and the security of the public required that it should be watched." So also Mr. Justice Coltman, in the case of the *Queen* v. *Weyman*, remarked, "that the defence of insanity was one which was to be watched with considerable strictness, because it was not any slight deviation from the conduct which a rational man would pursue under a given state of circumstances, which would support such a line of defence." When the punishment attached to an offence is not capital, it would appear that much stronger evidence is required to establish a plea of insanity than under other circumstances. This will be seen by reference to the case of the *Queen* v. *Grove*, Stafford Lent Assizes, 1843. The evidence of insanity was considerably stronger than that adduced in the case of *M'Naughten*, yet the prisoner was convicted! These two cases occurring so recently, the one after the other, display the uncertainty attendant upon a plea of this kind. So again it would be difficult to reconcile upon medical grounds, the conviction of *Francis* with the acquittal of *Oxford*, both of them tried for the same crime, (shooting at the Queen,) committed under similar circumstances. In the case of the *Queen* v. *Stolzer*, (Central Criminal Court, Oct. 1843,) where the charge was one of murder by stabbing, the plea was rejected, although no motive appeared, and there were some indications of insanity. In another case, (the *Queen* v. *Rowe*,) tried at the same time, the prisoner, an old man, deliberately fired a loaded pistol at his master, because he had discharged him from his service and would not take him back. There was no mark of insanity either in the act or in his previous conduct, but he was acquitted as insane, on the lenient presumption, that he might be labouring under the imbecility of age!

The case of *Reg.* v. *Laurence*, (Lewes Lent Ass. 1844,) affords a remarkable contrast to that of *M'Naughten*. The prisoner had been arrested by a constable for a petty theft: he was taken to the police-station, where the inspector, who was an utter stranger to him, was at the time engaged in talking to some friends, his back being turned to the prisoner. The man suddenly seized a poker and struck the inspector a violent blow on the skull from which he speedily died. The prisoner admitted that he struck the blow, that he had

no motive for the act; and that he would have struck any one else, who had been standing there at the time. He also said, he hoped the deceased would die, he was glad he had done it, and he wished to be hanged. The evidence at the trial showed that there was no cause of quarrel between the parties, but that the prisoner appeared to be actuated by some *sudden impulse* for which they could not assign the slightest reason. This man was left to a chance-defence; for the Court was actually obliged to assign counsel to him. There was no eloquent advocate to make a brilliant speech in his favour;—there were no medical witnesses, profoundly versed in the subject of insanity, to contend for the existence of a "homicidal climax," or of impulsive homicidal monomania; but there was simply a formal plea of insanity, resting upon the fact of the deceased being a stranger to him, and of there being consequently no motive for the act of murder. The jury negatived this plea, and the prisoner was convicted and executed! The only differences between this case and that of *M'Naughten*, were, that there was in *Laurence* less evidence of deliberation, with stronger evidence of sudden impulse; and there was not sufficient interest about the deceased, the prisoner, or his crime, to attract any great public attention!

This case had not long occurred, when another of a similar kind, was the subject of a trial at the Cent. Crim. Court, in October 1844. (*Reg.* v. *Hon. Ross Touchett.*) The prisoner, a young man, entered a shooting gallery in Holborn, took up a pistol and deliberately fired at the proprietor of the gallery while his back was turned, thereby inflicting a wound which ultimately led to his death, after the long period of eleven months. The prisoner was tried for shooting with intent to murder. The defence was insanity, founded on the absence of motive for the act, and on the presumption of hereditary taint. After having fired the pistol, he said he did it on purpose, for he wished to be hanged. There was no evidence of intellectual aberration: his landlady said he was a very regular and quiet person, and that he had complained of a sensation of boiling at the top of his head! Dr. Monro considered that at the time of the act, the prisoner was labouring under mental derangement. He admitted to him, that he had no knowledge of Mr. Smith, (the person whom he shot,) but that he wished to be hanged, and had been brooding over suicide for some years. He referred to the case of *Laurence*, who had killed a man at Brighton, (supra,) and said that he wished to do something of the same kind, in order to get himself hanged. He was acquitted on the ground of insanity. What distinction can possibly be made by physician or jurist between these two cases,—or how is it possible to lay down rules for the future guidance of medical witnesses under such capricious decisions? The acquittal of *Touchett* may have been perfectly right: but then the conviction and the execution of *Laurence* was a public wrong.

The principles of the English law have been closely scrutinised by medico-legal writers, and it has been abundantly proved, that the test of responsibility assumed by it is of a purely theoretical kind, and cannot be carried into practice. With this admission, it appears to me unnecessary to occupy space with metaphysical discussions regarding criminal responsibility; for however defective the rules, if the *practice* of the law be in any one case in conformity with that which has been advised by the best writers on the medical jurisprudence of insanity, this is all with which we have to concern ourselves: the principle is admitted. The great defect in the English law is, not that it will not go to the full extent of the doctrine, but the *uncertainty of its application*. The foregoing cases show that an acquittal on the plea of insanity, is left to be a mere matter of accident.

Among a large number of cases which have occurred since the publication of the first edition of this work, I shall select one of the most recent, as it shows plainly that the law makes no difficulty in admitting the plea of insanity, —even where it depends only on perverted moral feeling. The most strenuous advocate of irresponsibility in cases of moral insanity, can desire no better precedent than that furnished by the case of *Reg.* v. *Brixey*, Cent. Crim. Court, June 1845. (See Med. Gaz. xxxvi. p. 166.)

The prisoner was a quiet inoffensive girl, a maid servant in a respectable family. She had laboured under disordered menstruation, and a short time before the occurrence, had shown some violence of temper about trivial domestic matters. This was all the evidence of her insanity—the rest was furnished by the act of murder, a species of evidence, which in Greensmith's case (ante, p. 662) the judge positively declined receiving. She procured a knife from the kitchen on some trivial pretence, and while the nurse was out of the room, cut the throat of her master's infant child. She then went down stairs and told her master what she had done. She was perfectly conscious of the crime she had committed, and showed much anxiety to know whether she would be hanged or transported. There was not the slightest evidence that she was labouring under any delusion. The prisoner was acquitted on the ground of insanity. (See Med. Gaz. xxxvi. 166. 247.) In trying this case by the medical rules laid down for detecting homicidal monomania, (ante p. 666,) we shall see that it falls under the 3rd, 4th and 5th only; i. e. absence of motive,—no attempt at escape,—no accomplices. Admitting the probability of a connection existing between amenorrhea and insanity in the abstract, there was no more proof of insanity in the case of this girl, than in that of *Laurence;*—yet one was convicted and executed, while the other was acquitted! In the defence of Brixey, Mr. Clarkson uttered a plain medical and legal truth, in stating that, "*no general rules can be applied to cases of this sort.* Each case must be decided by the peculiar facts which accompany it."

Summary.—A strange and unaccountable notion prevails in the public mind, that a homicidal lunatic is to be distinguished from a sane criminal by some *certain* and invariable symptoms or characters which it is the business of a medical witness to display in evidence, and of a medico-legal writer to describe. But a perusal of the evidence given at a few trials will surely satisfy those who entertain this notion, that each case must stand by itself. It is easy to classify homicidal lunatics and say that in one instance, the murderous act was committed from a motive—i. e. revenge or jealousy; in a second, from no motive but from irresistible impulse; in a third, from illusion or a delusive motive—i. e. mental delusion; in a fourth, from perverted moral feeling. This classification probably comprises all the varieties of homicidal insanity, but it does not help us to ascertain *in a doubtful case,* whether the act was or was not committed under any of these psychological conditions. It will enable us to classify those who are *acquitted* on the ground of insanity, but it entirely fails in giving us the power to distinguish the sane from the insane criminal.

According to M. Esquirol, whose views, more or less modified, are adopted by all other writers on the medical jurisprudence of insanity, the facts hitherto observed, indicate *three degrees* of homicidal monomania.

1. In the first the propensity to kill is connected with absurd motives or actual delusion. The individual would be at once pronounced insane by every body. Cases of this description are not uncommon, and they create no difficulty whatever. The accused are rarely allowed even to plead to the charge.

2. In the second class, the desire to kill is connected with no known motive. It is difficult to suppose that the individual had any real or imaginary motive for the deed. He appears to be led on by a blind

impulse which he resists and ultimately overcomes. (Case by Mr. Daniell, antè, p. 670.)

3. In the third class, the impulse to kill is sudden, instantaneous, unreflecting and uncontrollable, *(plus forte que la volonté.)* The act of homicide is perpetrated without interest, without motive and often on individuals who are most fondly loved by the perpetrator. (Maladies Mentales, ii. 834.)

These three forms differ from each other only in degree ;—the two first being strongly analogous to, but lighter modifications of the third. All the cases which came before M. Esquirol had three characters in common. An irritable constitution, great excitability—singularity or eccentricity of character : and previously to the manifestation of the propensity, there was a gentle, kind and affectionate disposition. As in other forms of insanity, there was some well-marked *change of character* or in the mode of life. The period at which the disorder commenced and terminated, could be easily defined and the malady could be almost always referred to some moral or physical cause. In two cases it was traced to the result of puberty and in four to the power of imitation. Attempts at suicide preceded or followed the attack: all wished to die, and some desired to be put to death like criminals. In none of the cases, was there any motive for the act of homicide.

M. Esquirol believes that there are well-marked distinctions between this state and that of the sane criminal. Among these he enumerates, 1st, the want of accomplices in homicidal monomania. 2nd, The criminal has *always* a motive—the act of murder is only a means for gratifying some other more or less criminal passion; and it is almost always accompanied by some other wrongful act. The contrary exists in homicidal monomania. 3rd, The victims of the criminal are those who oppose his desires or his wishes:—the victims of the monomaniac, are among those who are either indifferent, or who are the most dear to him. 4th, The criminal endeavours to conceal, and if taken, denies, the crime ; if he confesses it, it is only with some reservation and when circumstances are too strong against him ; but he commonly denies it to the last moment. It is the reverse with the monomaniac.

The exceptions to which these characters are open, have been already considered (ante, p. 666.) They have undoubtedly greater value in their united than in their individual application, and when in any case they co-exist, there is strong reason to believe that the accused party is irresponsible.

Some doubt has existed whether a medical witness, on a trial in which the plea of insanity is raised, could be asked his opinion respecting the state of the prisoner's mind at the time of the commission of the alleged crime,—whether the accused was conscious at the time of doing the act, that he was acting contrary to law, or whether he was then labouring under any and what delusion. It has been now decided by fourteen judges out of fifteen, that facts tending to lead to a strong suspicion of insanity must be proved and admitted, before the opinion

of medical witnesses can be received on these points. It is proper that a medical witness should remember, in examining an accused party, who is alleged to have committed a crime while labouring under insanity, that the plea may be good, and yet the individual be *sane*, when examined. This was observed in the case of a lunatic, who killed his mother, in February 1843. There was no doubt that he was insane at the time of the act; but two days afterwards, he was found to be of perfectly sound mind. This sudden restoration to reason, is sometimes met with in cases of homicidal mania. For a remarkable case of this description, where the motive for a man killing his wife was apparently jealousy, see report by MM. Leuret, and Ollivier, Ann. D'Hyg. 1843, ii. 187; also 1836, ii. 122. Lord Hale, mentions a case where a woman soon after her delivery, killed her infant. She confessed the crime, was carried to prison, fell into a deep sleep, wakened quite sane and wondered how she came there. (See also the case of *M'Callum*, Alison, 650.)

CHAPTER LXI.

SUICIDAL AND PUERPERAL MANIA. PYROMANIA. KLEPTOMANIA. DIPSOMANIA.

Suicidal Mania.—In monomania, especially in that form which is called melancholia, or lypemania, there is often a strong propensity to the commission of suicide. This may proceed from sudden impulse or from delusive reasoning. Suicidal mania is susceptible of being spread by imitation, more especially where the mode of self-destruction adopted, is accompanied by circumstances of a horrible kind, or exciting great notoriety. The sight of a weapon or a particular spot where a previous suicide has been committed, will often induce a person, who may have been hitherto unsuspected of any such disposition, at once to destroy himself. In some instances an individual fancies that he is oppressed and persecuted, that his prospects in life are ruined, when on the contrary, his affairs are known to be flourishing. He destroys himself under this delusion. In cases of this description, whether arising from a momentary insane impulse, or from delusive reasoning, there cannot bea doubt that the act is one of insanity. It is very different, however, where a real motive is obviously present,—as where an individual destroys himself to avoid disgrace, or impending ruin, because here the results are clearly foreseen, and the suicide calculates that the loss of life would be a smaller evil, than the loss of honour and fortune. It may be urged that a motive of this kind will appear insufficient to the minds of most men;—but what known motive is there sufficient to account for parricide, infanticide, or any other crime of the like horrible nature? It appears to me we must allow either that all crime is the offspring of insanity, or that suicide is occasionally the deliberate act of a *sane* person. To say, that suicide is always *per se* evidence of insanity, is to say substantially, that there is no

criminality in self-murder; for it is impossible to regard that act as a crime, which is committed under a really insane delusion. (See Ann. D'Hyg. 1831, i. 225.)

The law of England, however, very properly treats suicide as felony; those who have attempted and failed in its perpetration, are treated as sane and responsible agents, unless there should be very clear evidence of insanity; and it is pretty certain, that the evidence so required must be much stronger, than that sometimes admitted in cases of homicide. Thus had *Oxford* and *M'Naughten* attempted to destroy themselves and failed, and in making the attempt on their own lives by a pistol or otherwise, had accidentally led to the death of a bystander, and had afterwards been tried for the felony, it is almost certain that they would have been convicted. The hypothesis of a *suicidal climax* would have been rejected. The facts adduced at their trials, would most probably, under these circumstances, have been deemed insufficient to establish their insanity and consequent irresponsibility for the attempts on their own lives. Some singular medico-legal cases have lately occurred involving the question—how far the act of attempting suicide, is indicative of insanity.

In the case of the *Queen* v. *Rumball*, (Cent. Crim. Court, May 1843,) the prisoner was charged with attempting to drown her child. It appeared in evidence that she fastened her child to her dress and threw herself into a canal with the intention of destroying herself. She was rescued, and she was tried and convicted of the felony of attempting to murder her child by drowning. Had she not been rescued and had succeeded in her purpose of self-destruction, it is very probable that the verdict of a jury would have been, as it so frequently is on these occasions—"temporary insanity." In the case of *Reg.* v. *Furley*, Cent. Crim. Court, April 1844, the prisoner was convicted of murder under similar circumstances, but the sentence was subsequently commuted. In the case of the *Queen* v. *Gathercole*, 1839, a man was charged with the manslaughter of the deceased, under the following singular circumstances. The prisoner threw himself into a canal for the purpose of drowning himself: the deceased, who was passing, jumped in and rescued him; but by some accident he was himself drowned in the humane attempt. The defence was, that the prisoner was at the time insane, and therefore not responsible for the death of the person who attempted to save him; but this was negatived, and the prisoner was convicted. So if a man intending to shoot himself fails, and by accident shoots a bystander, he will be held responsible, unless there be very clear proof of insanity:—the act—the attempt itself, taken alone, will not be admitted as evidence.

It is well known that a policy of life-assurance is forfeited by the act of suicide according to the rules of some Offices; but supposing it to have been really an act of insanity, would it be legally forfeited? In an equitable view, the policy should not be forfeited under these circumstances, any more than if the party had died accidentally by his own hands. The condition truly implies that the party puts himself to death *deliberately*, and not unconsciously while labouring under a fit of delirium or insanity. This question was raised but not satisfactorily decided in the case of *Borradaile* v. *Hunter*, (Dec. 1841).

This was an action brought to recover the amount of a policy of insurance effected on the life of a clergyman who threw himself into the Thames from

Vauxhall Bridge and was drowned. The whole question turned upon the legal meaning of the words "*die by his own hand,*" which formed the exception in the proviso to the payment of the policy. At the trial of the case, Erskine, J., told the jury that if the deceased threw himself into the river, knowing that he should destroy himself and intending so to do, the policy would be void:—they had further to consider, whether the deceased was capable of distinguishing between right and wrong at the time, or in other words, whether he had a sufficient knowledge of the consequences of the act to make him a felo-de-se. The jury found that the deceased threw himself into the water intending to destroy himself; and that previously to that time, there was no evidence of insanity. They were then directed to take the act itself with the previous conduct of the deceased into consideration, and say whether they thought, at the time, he was capable of knowing right from wrong. They then found that he threw himself from the bridge with the intention of destroying himself, but that he was not then capable of judging between right and wrong. The jury were here evidently perplexed with the strict meaning of the words right and wrong:—the first part of the verdict made the case one of felo-de-se, the last part made it one of insanity. The verdict was entered for the defendants, i. e. that the deceased was a felo-de-se, and that the policy was void. The case was subsequently argued before the four judges in the Common Pleas, May 1843: it was contended for the plaintiff, that according to the terms of the policy there must have been an *intention* by the party assured, to "die by his own hands;" and that an insane person could have no controllable intention. The judges differed:—three considered that there was no ground for saying that the deceased was affected by an uncontrollable impulse,—on the contrary, the jury had found that he threw himself into the river, knowing that he should destroy himself and intending to do so. In their opinion, the act was one of felo-de-se, and the policy was void. Tindal, C. J., considered, that the verdict should be for the plaintiff, thereby leading to the inference, that the act of suicide was in this case the result of insanity, and not of a felonious killing, to which alone he considered the exception in the proviso should apply. It is probable that if the term "*suicide*" had been inserted in the policy instead of "*die by his own hand,*" the decision would have been in favour of the plaintiffs: for to vitiate a policy from an accidental result depending on an attack of insanity and *flowing directly from that attack*, is virtually vitiating it for the insanity itself! In this respect, it appears that the learned Chief Justice took a most sound and equitable view of this question, so important to the interests of those, who have insured their lives. It is impossible for a man to enter into a contract *against an attack of insanity*, any more than against an attack of apoplexy! The jury found that the deceased was irresponsible for the act, and it is clear that the insurers and insured intended no more by using the terms "die by his own hand" than the act of suicide. By the decision therefore, they received the benefit of a wider interpretation than that which either party could have foreseen. This question has again been raised in the case of *Schwabe* v. *Clift*, Liverpool Summer Ass. 1845. (Med. Gaz. xxxvi. 826.) The deceased, whose life was insured, destroyed himself by taking sulphuric acid. There was clear evidence of his being at the time in a state of insanity. The jury here, under the direction of Cresswell, J., took a most proper view of the subject, and returned a verdict for the plaintiffs, thereby deciding that the policy was not vitiated by the mere act of *suicide*. The learned judge held that to bring the case within the terms of the exception, the party taking his own life, must have been *an accountable moral agent and able to distinguish right from wrong*. In this case, the term "suicide" was used in the policy, which the learned judge held to imply "a *felonious* killing." Supposing that the insured party was killed by voluntarily precipitating himself from a window, while in a fit of delirium from fever, this would be an act of suicide or dying by his own hand; but it surely cannot be equitably contended that his heirs should lose the benefit of the insurance in consequence of an event depending on an accidental attack of a disease, which no one

could have foreseen and against which no one could guard. If this principle be not admitted, the decision which follows would appear to be against all equity; if it be admitted, then it must apply equally to every case of mental disorder, the proof of the existence of this resting with those who would benefit by the policy.

From these cases one point is clear,—the act of suicide is not treated by the law as a necessary *proof of insanity*; and therefore the ingenious arguments which have been held on this subject, have but little interest for the medical jurist in a practical view. It has been elsewhere stated, that acts of suicide have been mistaken for homicide, merely because the deceased had expressed no *intention* of destroying himself, and had manifested no disposition to the act by his previous conduct. This, however, is a very fallacious view of the subject; since suicide from sudden impulse is by no means unfrequent; and even where the act bears about it marks of deliberation, it is not to be expected that the individual should previously announce his intention; for this would be a sure way of defeating his object. Perhaps one of the most remarkable instances of suicide from sudden impulse, is the following, which is related by Sir Charles Bell:

Many years since one of the surgeons of the Middlesex Hospital was in the habit of going every morning to be shaved by a barber in the neighbourhood, who was known as a steady, industrious man. One morning some conversation arose about an attempt at suicide which had recently occurred; and the surgeon remarked that the man had not cut his throat in the right place. The barber then casually inquired where the cut should have been made; and the surgeon pointed to the situation of the carotid artery. A few minutes afterwards, the surgeon was alarmed by hearing a noise at the back of the shop, and on rushing to the spot, found that the barber had cut his own throat with the razor with which he had been shaving him. The man speedily died!

The tendency to suicide is undoubtedly hereditary. Dr. Burrows relates an instance in which this propensity declared itself through three generations:—in the first, the grandfather hung himself: he left four sons, one hung himself, another cut his throat, and a third drowned himself in an extraordinary manner after having been for some months insane: the fourth died a natural death, which from his eccentricity and unequal mind was scarcely to be expected. Two of these sons had large families—one child of the third son died insane—two others drowned themselves, another is now insane and has made the most determined attempts on his life. Several of the progeny of this family, being the fourth generation, who are now arrived at puberty, bear strong marks of the same fatal propensity.

PUERPERAL MANIA.—A homicidal propensity towards their offspring, sometimes manifests itself in women, soon after parturition. It seldom appears before the third day, often not for a fortnight; and in some instances not until several weeks after delivery. The most frequent period is about the commencement of lactation and between that and the cessation of the lochia. (Burrows.) According to Esquirol, it is generally attended by a suppression of the lochia and milk. The

symptoms do not differ from those of mania generally; but it may assume any of the other forms of insanity; and in one half of the cases it may be traced to hereditary tendency. According to Dr. Burrows, there is delirium with a childish disposition for harmless mischief. The woman is gay and joyous, laughing, singing, loquacious, inclined to talk obscenely and careless of every thing around. She imagines that her food is poisoned—she may conceal the suspicion, and avoid taking what is offered. She can recognise persons and things, and can, though perhaps will not, answer direct questions. Occasionally there is great depression of spirits with melancholia. These facts are of some importance in cases of alleged child-murder. It may last a few hours or for some days or weeks. The murder of the child is generally the result of a sudden fit of delirium: or of an uncontrollable impulse, with a full knowledge of the wickedness and illegality of the act,—so that the legal test of responsibility of a knowledge of right and wrong, cannot be applied to such cases. Mothers have been known, before the perpetration of the murder, to request their attendants to remove the child. Such cases are commonly distinguished from deliberate infanticide, by there being no attempt at concealment nor any denial of the crime on detection. Several trials involving a question of puerperal mania, have been decided, generally in favour of the plea, within the last few years. Dr. Ashwell has remarked, that undue lactation may give rise to an attack of mania, under which the murder of the offspring may be also perpetrated. (Diseases of Women, 732.) Females in the *pregnant* state have been known to perpetrate this crime apparently from some sudden perversion of their moral feelings. I am not aware that a plea of exculpation on the ground of insanity, has been admitted in this country under these circumstances. (See case Ann. D'Hyg. 1831, i. 374.)

Pyromania.—This is described as a variety of monomania in which there is a morbid disposition of mind, leading to acts of incendiarism, without any motive. It is said to proceed from sudden impulse or from delusive reasoning, but most commonly the latter. It has been chiefly remarked in females about the age of puberty, and is supposed to be connected with disordered menstruation. An extraordinary instance of pyromania is quoted in the case of Jonathan Martin, who fancied himself to be deputed from God to burn down the cathedral of York, in order to do away with the heresies which he supposed to exist in the church. It is said to be not uncommon in young persons about the age of puberty. Admitting that a morbid impulse of this kind may exist, it should be very cautiously received as an exculpatory plea; since it might be easily converted into a means for withdrawing real criminals from all legal control. The plea has been already admitted in the English Law. (See cases Med. Gaz. xii. 80. Ann. D'Hyg. 1833, ii. 357; 1834, ii. 94.)

Several important trials in which this plea was urged in defence, have taken place within the last two years. Among these, the one most interesting to the medical jurist was that of *James Gibson*, tried before the High Court of

Justiciary, Edinburgh, (Dec. 23, 1844,) and of which a very full report will be found in Cormack's Edinburgh Journal, February 1845, page 141. The prisoner was charged with setting fire to certain premises, and the defence chiefly rested upon the allegation, that he was in a state of mind which rendered him irresponsible for the act. The medical evidence was generally in favour of the insanity. The Lord Justice Clerk (Hope) in a very elaborate charge to the jury, laid down most of the legal propositions for their guidance, which have been already discussed under homicidal mania. He remarked that they were "not to consider insanity according to the definition of medical men,—especially such fantastic and shadowy definitions, as are to be found in Ray, whose work was quoted by the counsel for the panel, and in many other medical works on the subject." He adopted Mr. Alison's view, that the consciousness of right and wrong must be applied to *the particular act*, and not to crime in the abstract. "The duty of deciding this question, is with the jury; it is not to be delegated to medical men, and by relying upon their own judgment, their decision would be nearer the truth, than that of any body of medical witnesses." The jury negatived the plea, and the prisoner was sentenced to transportation for fourteen years. It appears to me from the whole of the evidence, that there was no more insanity in the case of this man, than in the case of *Macnaughten*; and had the latter robbed the late Mr. Drummond of his property, or burnt his house down, instead of shooting him, he would probably have been convicted and transported. In the case of *Reg.* v. *Elderfield*, Guildford Summer Ass. 1844, the prisoner was charged with arson, and Gurney, B., left it to the jury to say, not whether the prisoner had a weak or silly mind, but whether at the time he committed the act, he was in such a state of mind as to know what he was about and to be capable of distinguishing between right and wrong. The prisoner was acquitted on the ground of insanity. In another case, *Reg.* v. *Watts*, Norwich Winter Ass. 1844, the plea was negatived under the direction of the judge.

KLEPTOMANIA.—This term has been applied by Marc, to that form of monomania which manifests itself by a propensity to acts of theft. It has been remarked by him and others, that this propensity has often shown itself in females labouring under disordered menstruation, or far advanced in pregnancy, the motive being the mere wish of posession. Pregnancy, according to him, should be a good exculpatory plea, where a well-educated woman of strictly moral conduct steals some unimportant article of no value compared with her worldly means and position in society. There are many instances on record, where well-educated persons moving in a respectable sphere of society, have been guilty of petty acts of theft. The articles taken have been valueless compared with their means. Instances of this kind have been brought before our police-courts: and this motiveless impulse to theft has been occasionally pleaded; but in most of these, the following facts have been established by evidence: 1. A perfect consciousness of the act. 2. The article, although of trifling value, has still been of some use to the person,—thus these females have stolen articles only adapted to female use. 3. There have been art and precaution in endeavouring to conceal the theft; and 4, a denial of the act when detected, or some evasive excuse. When circumstances of this kind are proved, either the parties should be made responsible, or theft should be openly tolerated. The evidence of a disordered state of the mind, should not be here allowed to depend on the nature of the act, or every morally depraved person might bring forward a plea of in-

sanity for any crime or offence. (See case Ann. D'Hyg. 1838, ii. 435.) When the plea of insanity is raised in respect to other cases of theft, the rule appears to be, per Tindal, C. J., that there should be proof that the prisoner was incompetent to know that the particular act in question was a wrong one. (*Reg.* v. *Vaughan*, Monmouth Sum. Ass., 1844.) In one instance which occurred lately, an acquittal took place on the ground of insanity (kleptomania) from amenorrhea. (Carlisle Sum. Ass. 1845, *Reg.* v. *Shepherd.*) Cormack's Ed. J., Aug. 1844.

Dipsomania, Drunkenness.—This state, which is called in law frenzy, or "*dementia affectata,*" is regarded as a temporary form of insanity. Jurists and legislators have differed widely respecting the degree to which drunkards should be made responsible for their acts. When the mind of a man is completely weakened by *habitual* drunkenness, then the law infers irresponsibility, unless it plainly appear, that the individual was at the time of the act, whether of a civil or of a criminal nature, endowed with full consciousness and reason to know its good or evil tendency. Any *deed or agreement* made by a party while drunk, is not invalidated by our law, except in the case where the intoxication has proceeded so far as to deprive him of all consciousness of what he is doing; and a Court of Equity will not interfere, unless the drunkenness were the result of collusion by others for the purposes of fraud. When the drunkenness has occasioned a temporary loss of the reasoning powers, he is incapable of giving a valid consent, and, therefore, cannot enter into a contract or agreement, for this implies *aggregatio mentium*, i. e. a mutual assent of the parties. Partial drunkenness, therefore, provided the person knew what he was about, does not vitiate a contract or agreement into which he may have entered. Thus the law appears to make two states in drunkenness;—one where it has proceeded to but a slight extent, and where it is considered that there is still a power of rational consent:—another where it has proceeded so far that the individual has no consciousness of the transaction, and therefore can give no rational consent. The proof of the existence of this last state would vitiate all the civil acts of a party. A confession made by a man while in a state of drunkenness, is legally admissible as evidence against him and others, provided it be corroborated by circumstances. In a case recently tried, the prisoner confessed while drunk that he had committed a robbery and murder which had taken place some time before, but of which he had not been suspected. He mentioned a spot where the property of the murdered person had been concealed by him—and the whole of the circumstances of the murder. The property was found as he had described, and the case was clearly brought home to him, chiefly by collateral evidence from his own confession. He was convicted.

When *homicide* is committed by a man in a state of *drunkenness*, this is held to be no excuse for the crime. If voluntarily induced, whatever may be its degree, it is not admitted as a ground of irre-

sponsibility, even although the party might not have contemplated the crime when sober. (*Reg.* v. *Reeves*, Derby Winter Ass. 1844.) Thus it would appear that when the state of drunkenness is such as that any civil act of the person would be void, he may still be held legally responsible for a crime like murder. Some judges have admitted a plea of exculpation, where the crime has been committed in a state of frenzy arising from *habitual drunkenness*. But even this is not general. The question, whether the person was or was not drunk at the time of committing the crime, may be, however, occasionally of some importance. It was recently held by Patteson, J., that although drunkenness is no excuse for any crime whatever, yet it is of very great importance in cases where it is a question of *intention*. A person may be so drunk, as to be utterly unable to form any intention at all, and yet he may be guilty of very great violence. (*Reg.* v. *Cruse*, 8 C. and P. 546.) Again, where it is a question whether the accused was actuated by malice or not, the jury will have to take the fact of drunkenness into consideration, and this may have an influence upon their verdict. While then drunkenness does not furnish any excuse for a crime, it is often material with reference to the intent, with which the act has been perpetrated. (Law Times, Sept. 27, 1845, p. 542.) It is obvious, that if drunkenness were to be readily admitted as a plea of irresponsibility, three-fourths of the whole of the crimes in this country, would go unpunished. In those cases where the head has sustained any physical injury, as often happens with soldiers and sailors,—drunkenness, even when existing to a slight extent, produces sometimes a fit of temporary insanity, leaving the mind clear when the drunken fit is over. The law makes no distinction between this state and ordinary drunkenness, although juries occasionally show by their verdicts, that some difference ought to be made! (See cases in Alison, 653.) Hallucinations and illusions are a very common effect of drunkenness, and often lead to the commission of criminal acts. Marc relates a case where two friends being intoxicated, the one killed the other under an illusion that he was an evil spirit. The drunkenness of the accused was held to have been voluntary; and he was condemned to ten years imprisonment with hard labour. A case of this description was tried at the Norfolk Lent Assizes, 1840. (The *Queen* v. *Patteson*.) A man while intoxicated killed his friend, who was also intoxicated, under the illusion that he was some other person who had come to attack him. The judge made the guilt of the prisoner to rest upon whether, had he been sober, he would have perpetrated the act under a similar illusion! As he had voluntarily brought himself into a state of intoxication, this was no justification. He was found guilty of manslaughter, and sentenced to two months' imprisonment. *Drunkenness*, even when habitual is not a sufficient ground for *restraint or interdiction* in the English law. Thus, on a commission in Nov. 1836, a jury returned that the party was of weak mind and given to habits of drunkenness, but he was not of unsound

mind. On application, the Lord Chancellor refused to interfere. *In re Holden.*

Delirium Tremens.—This is a disordered state of mind which proceeds from the abuse of intoxicating liquids. Habitual drunkenness appears to be the predisposing, while abstinence from drink is the immediately exciting cause. Thus, the disorder frequently does not show itself, until the accustomed stimulus has been withdrawn for a certain period. It commences with tremors of the hands, by which it is known from ordinary delirium, and restlessness; and the individual is subject to hallucinations and illusions sometimes of a horrible kind, referring to past occupations or events. The patients are often violent, and prone to commit suicide or murder, more commonly the former; hence they require close superintendence. Persons labouring under this disorder, are incompetent to the performance of any civil act, unless the mind should clear up before death. They are not responsible for criminal acts committed while they are labouring under an attack. Acquittals have even taken place on charges of murder, where there was deliberation and an apparent motive for the act. Thus, then, although this disorder is voluntarily brought on by habitual drunkenness, the law admits it as a sufficient plea for irresponsibility; while in a case of confirmed drunkenness, it rejects the plea. Why the mere circumstance of the one being a remote consequence, and the other not, should create irresponsibility, it is difficult to explain. A trial has recently taken place in which the evidence showed that the homicide had been committed by an individual while labouring under an attaek of delirium tremens, (*Reg.* v. *Simpson*, Appleby Sum. Ass. 1845.) The prisoner's mind had become unsettled from an attack of this disorder brought on by habitual drunkenness. In another case, just decided, the plea appears to have been admitted without difficulty. (*Reg.* v. *Watson*, York Winter Ass. 1845.)

Somnambulism.—It has been a contested question among medical jurists, how far a person should be held responsible for a criminal act, perpetrated in that half conscious state which exists when an individual is suddenly roused from sleep. There is no doubt, that the mind is at this time subject to hallucinations and illusions which may be more persistent in some persons than in others; but it is difficult to suppose, unless we imagine that there is a sudden access of insanity, that an individual should not recover from his delusion, before he could perpetrate an act like murder. A remarkable case of this description, that of *Bernard Schedmaizig*, will be found in Marc (i. 56); and a trial involving this question occurred in England within the last few years. A pedlar who was in the habit of walking about the country armed with a sword-stick, was awakened one evening, while lying asleep on the high road, by a man, who was accidentally passing, seizing and shaking him by the shoulders. The pedlar suddenly awoke, drew his sword and stabbed the man, who soon afterwards died. He was tried for manslaughter. His irresponsibility was

strongly urged by his counsel on the ground, that he could not have been conscious of an act perpetrated in a half-waking state. This was strengthened by the opinion of the medical witness. The prisoner was, however, found guilty. Under such circumstances, it was not unlikely that an idea had arisen in the prisoner's mind that he had been attacked by robbers, and therefore stabbed the man in self-defence. (The *Queen* v. *Milligan*, Lincoln Aut. Assizes, 1836.) The following remarkable case is quoted by Mr. Best. Two persons who had been hunting during the day slept together at night. One of them was renewing the chase in his dream, and imagining himself present at the death of the stag, cried out "I'll kill him! I'll kill him?" The other awakened by the noise, got out of bed, and by the light of the moon, beheld the sleeper give several deadly stabs with a knife, on the part of the bed his companion had just quitted. Suppose a blow, given in this way, had proved fatal, and that the two men had been shown to have quarrelled previously to retiring to rest! (Presumptions of Law and Fact.)

Somnambulism may become a subject of discussion under a contested policy of life-insurance, in which it may be provided that it shall be vitiated by suicide. If a man falls from a height, and is killed while in a state of somnambulism—Would this be considered an act of suicide within the meaning of the policy? The proviso can only equitably refer to *felonious* killing, a view, which I believe the majority of our judges are inclined to take. (See cases ante, *Borradaile* v. *Hunter*, p. 677; also, Med. Gaz. xxxvi. p. 826.) It is impossible to give any general opinion relative to cases of this description; since the circumstances attending each case, will sufficiently explain how far it was likely that the murder or the suicide had been committed in a state of somnambulism or under an illusion continuing from a state of sleep.

THE DEAF AND DUMB.—It was formerly laid down in the old law books, that a person born deaf and dumb was by presumption of law an idiot; but in the modern practice want of speech and hearing, does not imply want of capacity either in the understanding or memory, but only a difficulty in the means of communicating knowledge; and where it can be shown that such a person has understanding, which many in that condition discover by signs, he may be tried and suffer judgment and execution. (Archbold.) A deaf and dumb person is not incompetent to give evidence, unless he be also blind. He may be examined through the medium of a sworn interpreter, who understands his signs. This condition does not justify restraint or interdiction, unless there be at the same time mental deficiency. A deaf and dumb person who has never been instructed, is altogether irresponsible for any action, civil or criminal. Such a person cannot even be called on to plead to a charge, when there is reason to suppose the nature of the proceedings cannot be understood. A deaf and dumb female was charged with cutting off the head of her child. By signs she pleaded not guilty: but she could not be made to understand the nature of the other proceedings against her. Upon this, she was discharged, and

subsequently confined as a criminal lunatic. In *Reg.* v. *Goodman.* (Stafford Summer Ass. 1841,) a deaf and dumb man was convicted of theft, and sentenced to imprisonment. He was made to comprehend the proceedings by signs and talking with the fingers. In *Reg.* v. *Brooke,* (Buckingham Summer Ass. 1842,) the prisoner could read and write well. He was charged with feloniously cutting and stabbing. The proceedings were reported to him in writing. He was convicted, and the judge (Alderson, B.) having sentenced him to a year's imprisonment, handed down his judgment in writing, which he recommended him to read and ponder over in prison! In *Reg.* v. *Jackson* (Bedford Summer Ass. 1844,) Alderson, B., held, that before the evidence of a dumb witness can be received, the Court must be satisfied that he comprehends the obligation of an oath. It has been decided in the ecclesiastical courts, that the consent of a deaf and dumb person given by signs, renders a matrimonial contract valid, provided the individual have a full and proper understanding of their meaning.

From these statements, it will be perceived that medical evidence is but of little importance in relation to the deaf and dumb. Indeed there are only two cases in which this kind of evidence is likely to be called for: 1, where there is accompanying *mental deficiency,* in which case, the general rules given under insanity apply; and, 2nd, where there is a suspicion that the deafness and dumbness are *feigned.* There can be commonly no great difficulty in detecting an imposition of this kind. It will be found that the alleged deafness and dumbness did not come on until a motive existed, and that there was no apparent cause, but the very suspicious one of evading the responsibility for some offence committed. It requires great skill to maintain this imposture. Such persons are immediately thrown off their guard by addressing them in a voice a little above or a little below the common conversational tone. A change in the eye or the features, will at once indicate that they hear what is said. The ignorant impostor may be dealt with on the principle of "*ars est celare artem,*" by seriously proposing in a low voice to some medical friend who may be present, the necessity for the performance of some formidable surgical operation. The production of amputating instruments has been known to have a wonderful effect! If the impostor can write, he may perhaps be detected by the ingenious plan adopted by the Abbé Sicard. When the deaf and dumb are taught to write, they are taught by the eye. The letters are only known to them by their form, and their value in a word, by their exact relative position. A half-educated impostor will spell his words or divide them incorrectly, and the errors in spelling will have reference to sound, therefore indicating that his knowledge has been acquired through the ear, and not alone through the eye. A man who had defied all other means of detection, wrote down several sentences, in which the misspelling was obviously due to errors produced by the *sound* of the words. The Abbé pronounced the man to be an impostor without seeing him, and he subsequently confessed the imposition.

ADDENDA.

Evidence from chemical analysis. At page 52, in reference to the case of the *Queen* v. *Jennings*, I am informed that a verdict of death from natural causes was returned in the instance of one child, and an open verdict in the other. In the text it is erroneously stated that verdicts of natural death had been previously returned in both cases.

Quantitative analysis of the mineral acids.—In the section on sulphuric acid, at p. 80, the calculation of the quantity, is founded on the assumption that the acid is in the state of monohydrate, and that the equivalent of Barium is 70. If Barium be taken at 68·7, and the acid be in the state of bi-hydrate, this will make a difference in the results. In the text it should be "concentrated," instead of "common" oil of vitriol.

Tests for nitric acid.—At p. 86, it is stated in relation to the use of the sulphate of narcotine as a test for nitric acid, that "neither the iodic nor the chloric acid, produces the same effect." On repeating the experiment, however, with pure iodic acid, both solid and in a state of solution, as well as with chlorate of potash, I have found the results so similar, as to render it necessary to employ some method to distinguish them. The plan described in the text, of the production of deutoxide of nitrogen from the acid is the best; but in addition to this, iodic acid or an iodate is known by the action of sulphurous acid and starch; and a chlorate by the addition of strong sulphuric acid without narcotine.

Period at which death takes place from oxalic acid —At page 97, it is stated that the duration of the most rapid case of poisoning by this acid was ten minutes, but Dr. Ogilvy of Coventry has since met with a case, in a female aged 43, which proved fatal in *three minutes*. The quantity of poison taken was not known. Medical Gazette, xxxvi. p. 831: and Lancet, Aug. 23, 1845.

Locomotion after a large dose of prussic acid.—At pp. 249, 250, several cases are related, which tend to show that persons may perform many acts indicative of volition and consciousness after having taken large doses of prussic acid. In most of these cases the strength of the poison either was not, or could not be determined. Mr. Lowe, of Aldersgate-street, has furnished me with the particulars of a case, which is, perhaps, more instructive in this respect than any of those recorded in the text. On the 25th December, 1845, a man, (æt. 23,) swallowed two drachms of prussic acid—equivalent, as I ascertained by an analysis of a portion of the acid taken out of the same bottle, to 2·54 grains of anhydrous acid. After having taken the poison, he descended thirty stairs, and walked about twenty paces before he became powerless! He fell senseless while attempting to open the street-door. It may be as well to state that the young man died in the presence of others; there was no scream, nor any marked convulsions; he merely threw his arms about and breathed hard.

Poisoning by Strychnia.—At p. 266 it is remarked that the quantity of strychnia required to destroy life is not known. A case has just occurred at Manchester, in which an adult female died in two hours from the effects of *three grains* of this alkaloid, taken by mistake. Prov. Med. Jour. Dec. 24, 1845. This, I believe to be the smallest fatal dose yet recorded in an adult, although, probably one or two grains might suffice to kill. Dr. Watson has more recently reported a case in which a girl, aged thirteen, died in an hour from the effects of *three quarters of a grain* of this alkaloid. Cormack's Ed. Journal, Jan. 7, 1846.

Artificial inflation of the lungs in cases of infanticide.—At p. 458, it is stated that I have met with the report of one case only of infanticide, where a woman is alleged to have succeeded in artificially inflating the lungs of her child. Since this was written, I have seen a case reported in Henke's Zeitschrift der S. A. (iii. 1845), by Dr. Von Siebold, of Göttingen, in which this defence was actually made by the female. The child was found with its head cut off, and its lungs containing air! The woman's statement of the mode in which she inflated the lungs, was inconsistent with well-known facts, and the examiners did not hesitate to give a decided opinion that the air found in the lungs, was due to the act of respiration. The whole case shows clearly, that when a theoretical objection of this kind comes to be tested by practical rules, it ceases to present any difficulty.

Protracted gestation, p. 537.—A case is reported in the number of the American Journal of the Medical Sciences, for October 1845, (p. 338,) in which, on a question of bastardy, the jury found that gestation had been protracted to a period of 317 days, or forty-five weeks and two days. (The *Commonwealth* v. *Porter*.) With the exception of one instance, quoted in the text, from Dr. Murphy, this is the longest case of protraction on record.

APPENDIX.

ANALYTICAL TABLES OF POISONS.

COLOURED MINERAL POISONS.

Yellow.	Blue.	Green.	Red.
Massicot. (Oxide of lead.)	s Sulph. Copper.	Scheele's green. (Ars. Copper.)	Red Oxide Mercury
Turner's yellow. (Oxychlor. Lead.)	s Nitrate. Copper	Schweinfurth green. (Ars. and Acet. Copper.)	Nitric Oxide.— Cinnabar.
Orpiment.	s Ammoniuret.— Verditer.	Chloride. Copper.	Vermilion.
Turbith mineral.		Brunswick green. (Oxychloride.)	Litharge.
Chromate of Lead.		s Acetate copper.	Minium.
s ——— of Potash.		s Subacetate —	a Realgar.
		Carbonate —	s Bichromate Pot.
		s Sulph. Iron.	s Sulphuret Potassium.
Ammoniuret Iron.	*Smalt. (Ox. Cobalt.)*		
Iodide of Mercury.	*Prussian Blue.*		*Biniodide Mercury.*
a *Persulphrt. of Tin.*	*Indigo.*	*Oxide of Chrome.*	*Peroxide of Iron.*
a *Sulphrt. Cadmium*		s *Salts of Nickel.*	a *Oxysulphuret of Antimony.*
s *Ferrocyanate of Pot*			

Those substances marked in Italics have not been used as poisons.

s, Soluble in water; a, unchanged by sulphuretted hydrogen, or hydrosulphuret of ammonia.

Change of colour produced by Sulphuretted Hydrogen, or Hydrosulphuret of Ammonia in the Solutions of certain Metallic Poisons.

Yellow.	Orange Red.	Black or Brown.	White.	Green.
Arsenic (S.H.)	Salts of Antimony.	Lead.	Salts of Zinc.	Bichromate of Potash.
Dyer's Spirit. (Permur. Tin.)	Tartar Emetic.	Copper..		Chromate of Potash.
		Mercury		
		Bismuth.		
		Proto. Chlor. Tin.		
		Green Sulph. Iron. (Copperas) (H.S.A.		
Salts of Cadmium.		Nit. Silver.		
		Nickel (H S.A.)		
		Cobalt. (H.S.A.)		
		Tellurium.		
		Uranium.		

TABLE OF THE ALKALINE POISONS AND THEIR SALTS.

	Water.	Reaction.	Chlor. Platina. Tartaric Acid.	Sulphuric Acid.	Oxalic Acid.	Sulph. Lime.
Potash.	soluble.	alkaline.	precip.	efferves.	efferves.	precip.
Carb. and Bicarb.	sol	alk.	precip.			
Soda.	sol.	alk.		efferves.	efferves.	precip.
Carb. and Bicarb.	sol.	alk.				
Chloride Sodium.	sol.	neutral.				
Ammonia.	sol.	alk.	precip.	efferves.	efferves.	precip.
Sesquicarbonate.	sol.	alk.	precip.			
Iod. Potassium.	sol.	neutral.	pre. T. Acid.	Sd. hyd. S. pr.	Sd. hyd. S. pre.	
Sulphuret Potassium.	sol.	alk.	precip.			precip.
Nitrate of Potash.	sol.	neutral.	precip.			
Bitartrate of Potash.	sol.	acid.				
Binoxalate of Potash.	sol.	acid.				precip.
Alum.	sol.	acid.				
Barytes.	sol.	alk.		precip.	precip. sol.	precip.
Chlor. Barium.	sol.	neutral.		precip.		precip.
Nitrate of Barytes.	sol.	neutral		precip.		precip.
Acetate of Barytes.	sol.	neutral.	pre. T. A. sol.	Acet. ad. evolv.	precip. sol.	precip.
Carbonate of Barytes.	insol.			efferv. ins.	efferves.	
Lime.	sol.	alk.	pre. T. A. sol.		precip.	
Salts of Lime.	sol.	neutral.		pre. if concent.	precip.	precip.
Strontia.	sol.	alk.		precip.	precip.	
Salts of Strontia.	sol.	alk.		precip.	precip.	precip.

N. B. The substances in italics are not commonly ranked among poisons.

ACID POISONS.

	Nit. Barytes.	Nit. Silver.	Sulph. Lime.
Sulphuric acid	precipitate insol. in nitric acid.		
Sulphate of Indigo			
Nitric acid			
Muriatic acid		precipitate insol. in nitric acid.	
Nitromuriatic acid		precipitate insol. in nitric acid.	
Nitrosulphuric acid	precipitate insol. in nitric acid	precipitate in sol. nitric acid.	
Oxalic acid		precip. sol. in nitric acid.	precipitate sol. in nitric acid.

Metallic irritants. Colourless mineral poisons.

	Heat.	Water.	Sulphuretted Hydrogen.	Hydrosulphuret of Ammon.	Potash.	Iodide of Potassium.
Arsenious acid....	volatile.	sol. with difficulty.	yellow prec.		soluble.	
Arsenic acid.....	fixed.	very soluble.	yellow.		soluble.	
Corros. sublimate..	volatile.	soluble.	black.	black.	orange yellow prec.	scarlet precip.
Calomel	volatile.	insoluble.	black.	black.	black.	green yellow.
White precipitate.	volatile.	insoluble.	black.	black.	yellow by heat.	orange.
Nitrate mercury..	vol. decompd.	soluble.	black.	black.	black.	yellow.
Pernitrate	vol. decompd.	soluble.	black.	black.	orange yellow prec.	scarlet.
Bicyanide	vol. decompd.	soluble.	black.	black.		
Acetate Lead.....	carbonized.	soluble.	black.	black.	white.	yellow.
Subacetate.....	carbonized	soluble.	black.	black.	white.	yellow.
Nitrate.....	yellow decompd.	soluble.	black.	black.	white.	yellow.
Chloride.....	melts (fixed.)	soluble.	black.	black.	white.	yellow.
Sulphate.....	fixed.	insoluble.	black.	black.		
Carbonate	orange.	insoluble.	black.	black.		
Tartar emetic.....	carbonized.	soluble.	orange red.	orange red.	white p. sol.	
Chloride of Tin...	fixed.	soluble.	black.	black.	white p. sol.	
Dyer's Spirit.....	fixed.	soluble.	yellow.	yellow.	white p. sol.	
Sulphate of Zinc..	fixed.	soluble.	white.	white.	white p. sol.	
Carbonate	yellow.	insoluble.				
Acetate	carbonized.	soluble.	white.	white.	white p. sol.	
Oxide	yellow.	insoluble.				
Nitrate of silver..	fixed (melts.)	soluble.	black.	black.	brown.	pale yellow.
Subnit. Bismuth ..	yellow (fixed.)	insoluble.	black.	black.		brown.

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